ENGINEERING NEWS
AND
AMERICAN RAILWAY JOURNAL.

VOL. XXI. No. 23

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ENGINEERING NEWS.

THE MOST APPALLING CATASTROPHE in the history of mankind, due to the failure of the works of man, and one of the worst of great catastrophes due to any cause whatever, will make last week forever memorable. The circumstances of this disaster are too important and too intricate to be briefly summarized here, and are given elsewhere as completely as we are able to give them in this issue, with as careful an analysis as we can now make of the causes which led up to it, which may be briefly summarized in these words: The dam was originally (nearly half a century since) well constructed by good engineers for a useful purpose. It was patched up ten years ago, without any public supervision, under charge of an engineer who is even now not generally known to the profession, to make a pleasure ground for a hunting and fishing club, in a way which left it too weak for the duty imposed upon it, and hence was unquestionably defective and bad. How defective and how bad the meagre details do not allow us to say, and hence it would be unjust to assume that the work was done more carelessly or unwisely than has happened in the case of many other works, built under the supervision of very eminent engineers. The appalling consequences of the disaster should not lead us to forget that no degree of care or skill will absolutely ensure the stability of such work, and hence that the club which built this dam, and their engineer, may have in fact taken all the care which good engineers, in advance of this terrible event, would have ventured to say was essential. They are entitled to the benefit of this doubt until the contrary is proved; but the circumstances so far made public, so far as they can indicate conclusions, have an ugly look. It makes the terrible event additionally painful that, if it be not a disgrace to American engineering, which we do not think it is, it is a disgrace to our methods of public administration, that so terrible an engine of destruction should have been so carelessly built and kept under such inadequate supervision.

THE LOSS OF LIFE is still difficult to estimate, and probably will never be exactly known within several hundred, but as nearly as we can gather, the largest estimates now current are much more likely to be correct than the smaller ones. For reasons elsewhere more fully outlined, it seems to us quite certain, that the loss of life cannot have been less than 10,000, that it is very possibly 15,000, and that it may even rise as high as 20,000. Unfortunately, there has been no accurate census of the valley since 1880, since which date the population has been increasing at an exceptionally rapid rate; but in a general way it seems to be clear that there were 40,000 people living in the "Valley of Death," as it has been well rechristened, while the most detailed estimate which we have seen places the population when the disaster occurred at 54,850. Had any large proportion of this vast multitude survived, it would have led to enormous crowds about the point of greatest interest and population, Johnstown, whereas it was very notable that the number of survivors was quite small in comparison with the outsiders who flocked in as soon as any means of communication was established. Whether the real loss be 10,000 or 20,000, however, does not greatly affect the awfulness of the disaster, as will be seen in part from the list of prior great disasters which we give elsewhere, with fuller details, incapable of proper summary here.

THE MOST SERIOUS RAILWAY ACCIDENT of the week was a collision May 31 between a special and a wrecking train on the Dayton, Fort Wayne & Chicago Railway, near Coalton, O. A train leaves Coalton every morning carrying miners to the mines of the Corwin Coal Co. A wrecking train was expected from Wellston; but as word was received that this train had not left Wellston, the miners' train started, being backed up the track. The collision occurred on a curve. The wrecking train had 2 coal cars filled with ashes in front of the engine, and these telescoped the caboose of the other train; 3 men were killed and 10 seriously injured. The accident was apparently due to careless management.——A crossing accident occurred June 1 at East Hartford, Conn., on the New York & New England Railway. A heavy west-bound freight train was unable to stop at the proper place, east of the yard, on account of the grade, and ran into an east-bound train from Hartford, which had to cross the west-bound track to reach the main line. One man was killed and the engine and 13 cars were wrecked. Proper protection of the crossing, or the use of continuous freight-train brakes might have averted this accident.

THE FLOODS AND WASHOUTS are too numerous to be given on this page, and a long account will be found elsewhere. The failure of the dam above Johnstown, Pa., caused the most disastrous flood, and in this connection we notice the failure of the dam of the water-works reservoir at Santa Paula, Cal., soon after the water had been turned in, and the Mokelumne dam, near Lancha Plana, Cal., known as the Westmoreland dam.——The failure of the dam of the upper reservoir at Littleton, N. H., on May 21, is said by local reports to have been caused by the water soaking into the earth bank. The breach was about 20 ft. wide by 20 ft. deep, and the volume of water rushed down to the lower reservoir. The lower dam is of stone, and resisted the pressure, the water falling over its crest.

BRIDGE ACCIDENTS have been very numerous this past week, owing to the serious floods and storms. It is impossible to approximate the total number, but the following notes, taken from our exchanges, give some of the principal bridge wrecks: A number of highway bridges around Hornellsville and Friendship, N. Y.; iron highway bridges at Dalton and Dansville, N. Y.; railway bridge on the Buffalo branch of the Delaware, Lackawanna & Western Ry. at Waverly, N. Y.; bridges on the Western New York & Pennsylvania Ry. near Corning, N. Y.; railway bridge of the Northern Central Ry. at Watkins, N. Y.; 2 bridges on the Fall Brook Ry.; 2 bridges at Olean, N. Y.——In Pennsylvania: railway bridges at Belvidere, Menges Mills, Milton, and Montgomery; 8 railway and highway bridges at Lewiston; 7 bridges at Shamokin; Juniata river bridges at Mifflintown, Mexico, Port Royal, and Thomsontown; also bridges at Bolivar, Nineveh, Johnstown, Everrett, Granville, Keating, and Sinnemahoning. Trestle at Easton, Pa.; 5 new county bridges near Bedford, Pa.; 5 bridges on the Northern Central Ry. Several bridges near Sunbury.——In Maryland: the Western Maryland Ry. has lost 8 bridges between Sensheim, Pa., and Gunpowder Falls, Md.; 9 bridges in Frederick Co.; Monocacy river bridges; bridges at Loudoun, Point of Rocks, Laurel and Sheperdstown. In all, 64 bridges are reported to have been destroyed.——At Washington, D. C., 2 spans of Long bridge.——In Virginia: bridges at Petersburg and Fredericksburg, and several bridges on the Chesapeake & Ohio Ry.——In West Virginia, the West Virginia Central Ry. lost 3 bridges.

THE FOLLOWING RAILWAY BRIDGES are reported to be washed away or not safe to use: Pennsylvania Railroad: Granville bridge, Juniata river, about 3 miles west of Lewistown Junction and 169 miles from Philadelphia. Four spans washed away. Bridge 640 ft. long; built in 1887.——Mayes bridge, Juniata river, 171 miles from Philadelphia. Whole bridge wrecked. Five spans, 640 ft. long; built in 1860.—— Manayunk bridge, Juniata river, 2 miles west of McVeytown, and about 176 miles from Philadelphia. Whole bridge wrecked. Five spans 640 ft. long; built in 1871.—— Petersburg bridge, Shafer's Creek, about 1 mile west of Petersburg, and 209 miles west of Philadelphia. Whole bridge reported wrecked, but 2 spans are known to be down; 156 ft. long; built in 1887.——Viaduct bridge Conemaugh river, about 8 miles east of Johnstown and about 273 miles from Philadelphia. Single span of stone arch reported to be washed away; 80 ft. long; built in 1832 by the State.—— South Fork bridge, Conemaugh river, near South Fork, 159 miles from Harrisburg and 264 miles from Philadelphia. Two spans, iron girders; washed away; built between 1886 and 1888.——Little Conemaugh bridge, No. 6, Conemaugh river, just east of Johnstown, 170 miles from Harrisburg and 275 miles from Philadelphia. Two spans of iron girders; entirely destroyed; built in 1869.—— Philadelphia & Erie Railroad; Montgomery bridge, North Branch (Susquehanna), 22 miles from Sunbury, a large bridge; washed away; new one to be built.——Philadelphia & Reading Railroad; Sunbury bridge, Susquehanna, on the Williamsport Branch; 14 spans, 2,600 ft. long. Three spans carried away; built in 1883; cost from $8,000 to $10,000 a span; a single-track bridge.—— Milton bridge, Susquehanna, wooden bridge (Howe truss), built in two portions, 8 spans, about 1,250 ft. long. Completely destroyed; built in 1876.——Muncy bridge, Susquehanna, Williamsport Branch; 6 spans, 1,003 ft. long, wooden. Washed away; built in 1876.

THE PROPOSED MISSISSIPPI RIVER BRIDGE at New Orleans is of course being strongly opposed by the navigation interests there. The Mississippi River Commission held a meeting at New Orleans, May 27, and heard testimony from various witnesses. The steamship men were unanimous in their belief that if a bridge were built, the site should be above the city; while the river steamboat owners were sure that some point below the city was the proper site for the bridge.

A "SUBMARINE BRIDGE" is proposed between Sweden and Copenhagen by a Swedish engineer, Mr. RUDOLPH LILLEJEGRIST. The distance is 2½ miles and the proposed structure would join Elsinore to Helsingborg by a bridge made up of 100-ft. spans carrying a single line of rails. It is to be submerged sufficiently to allow ships to pass over it. The bridge would be encased in a double tube, with an outer skin of iron and an inner one of steel, and the space between the shells filled with concrete. It is foreseen that the outer shell might rust away in time, but it is believed that the concrete would remain intact and protect the steel. The piers would be ordinary caissons, filled with concrete and placed 100 ft. apart. The tubes would rest on these piers, and the girders would take a bearing on blocks inside the tube immediately over the piers. The tube would be floated out in 100-ft. lengths and lowered to place, and a massive collar of concrete put over the joints. Pontoons, with legs at each corner, worked by hydraulic rams, so as to give a stable platform, would be used in sinking the tubes. The estimated cost of the submerged work is about $3,500,000, not including the tunnel approaches.

THE SOUTHERN PACIFIC RAILWAY is doing a very sensible thing in making some practical experiments on the question of what is the best form for the head of rails, by planing the heads of a number of rails to a variety of different forms. Thus it planes off the rail corners to ⅛, ¼, ⅜, and ½ in.

corner radius, planes some of the sides vertical and some flaring outward, and planes completely away, on some of the rails, half or more of the tread bearing. In this way it is expected that definite indications will be given of what is the true form, and no doubt correctly; although the report of the Am. Soc. C. E. Committee on the "Proper Relation of Rail and Wheel Sections," which will be out shortly, and shows substantial unanimity among engineers and rail men, will make this largely a work of supererogation.

THE MANHATTAN ELEVATED RAILWAY is now laying 90-lb. rails exclusively, its original standard having been 50 and 56 lbs. It has recently contracted at Bethlehem for 1,500 tons of such rails at $28, receiving $18 for its old steel rails. Thus the exchange costs only $10 per ton apart from the increase of section. The Manhattan already has a large mileage of 90-lb. rails in its track, and the improvement resulting therefrom has been very marked. It is chiefly using with these rails the Fisher bridge joint, but is also putting in some long angle bars. It has abandoned as useless the cutting of rail ends to a bevel. The reports recently published that it was about to use or experiment with iron ties, of any kind, were without any foundation.

FIVE THOUSAND TONS OF IRON have just been sold at Cleveland for $13.60 a ton, and the market is in despair. It came from Chattanooga, and, at the price charged, the iron could not net the Tennessee foundry men more than $10 a ton. Gov. BROWN, the President of the Tennessee Coal & Iron Co., is reported to have said the manufacturers expect soon to sell iron at $8 to $9 a ton. It costs to send iron by rail from Alabama points to New York about $3.75.

THE ILLINOIS STEEL COMPANY, recently formed by the consolidation of three of the great steel making companies whose works are located near Chicago, will have the greatest capacity of any steel works under one ownership in the world. The Krupp works at Essen employ more men, but as they carry on all the processes of production including the mining, their output of finished product is less. The Illinois company can employ 10,000 men, and the total annual capacity of its works is 850,000 tons pig-iron, 975,000 tons steel ingots, 900,000 tons steel rails, 50,000 tons structural shapes, 50,000 tons wire rods, 60,000 tons merchant bars, 40,000 tons railway splices, and 15,000 tons nails.

THE PEOPLE'S RAPID TRANSIT CO., of New York, proposes to build an elevated railway from the Battery to Tarrytown. It has served notices on a large number of owners of property which lies in its proposed path, but beyond this, little is known of future prospects. Their plan is to buy property through the centers of blocks and build tracks through or over these buildings. The company expects to rent these buildings and to borrow money for construction on the real estate.

THE IVES STREET PAVING BILL, just signed by Governor HILL, authorizes the expenditure of $3,000,000 for street paving in New York, at the rate of $1,000,000 per year from date. As $400,000 is already appropriated for this year, this addition makes $1,400,000 available. The work will be under the control of the Commissioner of Public Works. Ex-Commissioner NEWTON estimated that it would take about $6,000,000 to decently pave this city; and that even then the utmost care would be required to make that amount reach over the part of the city most in need of pavements. What is now most wanted, however, is another bill putting a stop to the constant breaking of pavement for laying all manner of pipes, conduits, and wires. How this is to be done is another question.

THE ORDNANCE SURVEY OF SCOTLAND, an area of 30,902 square miles, has been completed excepting the counties of Wigtown, Kirkcudbright, Edinburgh, Haddington, Fife, and Kinross, which will have to be resurveyed on the 1-2500 scale. Maps of parishes on the 1-2500 scale have been published, and the whole of Scotland is published on the 1-in. scale in outline, and the area published with hills is 26,469 square miles, of which 1,943 square miles were published during the year. The survey of the towns in Scotland is completed. So says the progress report of Dec. 31, 1888.

PROPOSALS FOR MAKING MAPS of Cuyahoga Co., Ohio, will be received by the County Commissioners up to June 27. These maps, and tracings of them, are to be used for the decennial appraisement of real estate. WM. B. BREW, Clerk of Cuyahoga Co., will furnish all particulars. A bond of $10,000 is required if bid is accepted.

THE HIGHEST WATERFALL IN THE WORLD is claimed for New Zealand, in a letter published by Mr. MACKENZIE, H. M. R., in the Otago *Daily Times*. The fall is at Lake Ada near Milford Sound, and is described as falling 1,904 ft. in three leaps of 815, 751 and 338 ft. respectivly, all in a straight line.

THE PRESENT SEWERAGE SYSTEM OF NEW YORK and the best methods for improving upon existing conditions has been carefully examined into and reported upon by Mr. RUDOLPH HERING. The final report was handed in to the Commissioner of Public Works last week.

POLES AND WIRES have been removed from the streets of New York to the number of 1,682 of the former and 1,140 miles of the latter since Jan. 1, 1889. The Western Union Telegraph Co. is to remove all of its poles from the streets occupied by elevated railways and to string its wires on the latter.

A SAN DIEGO-JAPAN-CHINA STEAMSHIP LINE is contemplated as an outlet to the Atchison, Topeka & Santa Fé R. R., says an exchange. If this new line is put into operation, there will be Pacific lines from San Francisco, Tacoma, and San Diego.

THE NEW SOUND STEAMER CONNECTICUT, just put into service on the Providence Line, is 348½ ft. long over all, beam 48 ft. 2 ins., extreme width over guards 87 ft., depth of hold 17 ft., extreme depth forward 23½ ft., and extreme depth aft 20 ft. The engine was built by Cramp & Son, of Philadelphia. It is a compound oscillating engine, with cylinders 56½ and 104 ins. diameter, and 11 ft. stroke. The engines are said to be the largest of this type ever built in this country. At full speed of 30 turns per minute, and 110 lbs. steam-pressure, the engines are expected to develop 5,500 H. P. The boat has feathering paddle-wheels 28 ft. diameter, and 12 buckets, each 14 x 4½ ft. The designer of the *Connecticut* and its engines was GEORGE B. MALLORY, M. Am. Soc. C. E.

THE CITY OF PARIS has beaten her own record for the fastest time for one day of ocean steaming in her trip from Liverpool ending June 5. In her previous fast run, she made 511 miles in 24 hours. This time she made one day's record of 515 miles.

VESTIBULE CAR PATENT LITIGATION is not yet concluded. The Pullman company has now sued the Wagner company to restrain it from using the vestibule as a completed device, a patent having been issued to GEO. M. PULLMAN for the improvement after a two years' delay in the Patent Office. If successful in this suit, it is believed that the Wagner company will be prevented from using the vestibule improvement or any substitute therefor.

EXCESSIVE SWITCHING CHARGES, made by the New York, New Haven & Hartford company to the trunk lines with which it connects, are being investigated by the Connecticut legislature. It is proposed to pass a general law by which, when the managers of any two companies cannot agree upon a tariff of rates for transferring cars from one road to the other, either may appeal to the Railroad Commissioners, who shall fix upon an equitable charge for the service rendered.

THE COMPETITION OF THE CANADIAN PACIFIC with the other transcontinental railways is now being investigated by the Senate Committee on Interstate Commerce. After their session in New York they went west over the Canadian Pacific, and are taking testimony in Seattle and the other chief commercial cities of the far Northwest. Of course the shippers and business men there are clamorous for Canadian competition, especially as they have already voted large subsidies to companies which are building to a connection with the Canadian Pacific at the international boundary, and have invested heavily in their securities. Altogether, the advocates of "free trade in railway traffic" seem to be having things all their own way.

AN INDICTMENT for violation of the Interstate Commerce Law has been brought by the Federal Grand Jury at Chicago against ALEX. MACKEY, General Freight Agent of the Michigan Central Railroad, and several subordinate officials. It is claimed that the indicted parties gave a cut rate to the firm of Counselman & Day, of Chicago, on grain shipments last October. As the offence was committed before the amendments to the Interstate law were in force, the maximum penalty, if the parties are convicted, will be a fine of $5,000.

ANOTHER RAILWAY WAR has seemed to be not very far distant of late. In the Northwest the "Soo" and Canadian Pacific have been securing a large traffic, it is alleged, at secret cut rates. The Chicago, Burlington & Northern finally decided to meet this with an open reduction, and the other competitors for the Chicago and St. Paul traffic of course followed suit. The Burlington & Northern managers are severely blamed, but they declare that they have already presented their case to the Interstate Commission, which failed to take action, thus forcing them to put down rates in order to retain their business.

In the Southwest the Chicago & Alton is the disturbing element. Its request to be allowed to make a 10-cent rate on lumber from Missouri river points to Chicago, has been refused by the arbitrators of the Interstate Railway Association, and there are rumors that the Alton will soon withdraw from the Association. The live-stock traffic between the same points is also in dispute, and the Alton demands that it be given its share of the business. The warlike speeches of one of the Alton officers are not appreciated in New York financial circles. As one of the financial journals puts it: "He is putting on entirely too much war paint for the good of his employers." It it not unlikely that wiser and calmer counsels may prevail, and that the Alton will remain a member of the Association.

Chairman WALKER, of the Interstate Association, appeared this week before the Interstate Commission, of which he was recently a member, to defend the Chicago & Alton for charging for live stock per 100 lbs. instead of by the car load.

The prospect for a forced reduction throughout Kansas is somewhat mitigated by the report that the State Railroad Commissioners will withdraw from the position which they took in the Wichita case, as reported last week.

Pacific coast traffic prospects are injured by the Southern Pacific's notice that it intends to withdraw from the Transcontinental Association. The Union Pacific and the Northern Pacific are patching up their difficulties, however, and will probably soon close a permanent agreement settling fully the disputes over the construction of competing lines in Oregon and Washington.

THE CAROLINA OIL & CREOSOTE CO.'S SUIT turns out to have been simply the result of a quarrel among the directors for control, to all appearances. All differences are now compromised and settled, and the affairs of the company are on a firmer footing than ever. The suit of Gen. MAHONE and others against Col. WM. P. CANADAY and others composing the company was tried in the U. S. Circuit Court, on May 20, and it was disposed of on a basis of compromise agreeable to all parties concerned, and the suit abandoned, the injunction dissolved, and the bill dismissed.

As an immediate result of this compromise, there were, on this same May 20, a number of resignations in the board and appointments of new officers. Hon. WARNER MILLER, of New York, is now President, vice Mr. A. A. THOMAS; U. S. Senators JOHN R. JONES, of Nevada, and JOHN C. CALHOUN, of New York, succeeded in the board Col. E. R. BRINK, and Mr. R. E. HEIDE; and Mr. F. C. PRINDLE was appointed Superintendent and Engineer, to succeed Mr. J. N. SEBRELL. Col. CANADAY and Hon D. L. RUSSELL also resigned, but their resignations were not accepted. As it now stands, the Board of Directors includes, in addition those named above, Messrs. GEORGE WEST, A. A. THOMAS, WM. MAHONE, and J. F. DIVINE. This is a strong organization and promises even greater success than has already attended the affairs of this company.

This company is now engaged on a large contract for timber for use on the Nicaragua canal in its preliminary work at Greytown. This is the first contract, we believe, that has been made by the canal company for construction material.

The Johnstown Disaster.

It is even now exceedingly difficult to determine, from the mass of telegraphic matter which has been sent from the scene of this week's terrible disaster, any approach to the exact facts in regard to its cause or extent. We shall next week be able, we trust, to give a tolerably correct account of all the technical facts, at least, obtained on the ground by our own staff. We may be able to give some further details in this issue, received by wire from the scene of the disaster, but probably not. In the meantime, we make the best approach possible to a connected and complete account of the disaster.

We have succeeded in obtaining from old records and official reports, chiefly in the library of the American Society of Civil Engineers, a tolerably exact account of the original dam, as constructed for the old Pennsylvania canal, in 1842, this dam not having been increased in height appreciably, if at all, when restored in 1879-81 by the South Fork Hunting and Fishing Club, as has been stated, but simply made intact again. The original work consisted of earth filling and slate and other rock filling in about equal proportions, with slopes of 2 to 1 on the inside and 1 to 1 on the outside, with a rubble masonry heart wall laid in cement and averaging 5 ft. thick. The inside of this dam was faced with a rubble slope wall, and the height of the water level above the original surface was 62 ft., the dam itself being continued up for some feet further, so that no water ever ran over it, and probably to about the height which the president of the company assigns to the reconstructed work, 69 ft. A separate spillway was excavated through solid rock at the side of the dam, for discharging the water of the lake; and to the insufficient dimensions of this spillway, when tested by the greatest rainfall ever known in that region, rather than to any defect in the dam itself, the disaster seems to be chiefly, if not wholly, due.

The substance of the information which we have so far been able to obtain in regard to the original dam is in more detail as follows:

The construction of the dam which (in its later reconstructed form) has just failed, was first authorized in 1836, but it was not till 1839 that $70,000 was appropriated for it, and WM. E. MORRIS, Principal Assistant Engineer, and an able and experienced man, placed in charge of it, and also of the dam near Hollidaysburg, on the east side of the mountains, which latter was a smaller dam, 28 ft. high, 1,230 ft. long, overflowing 450 acres, and containing 320,000,000 cu. ft. of water. The estimated cost of this dam was $100,000.

The west dam, which has now failed, raised the water 62 ft., was 850 ft. long on top, covered 400 acres of ground, and stored up 480,000,000 cu. ft. of water, the estimated cost being $188,000, and one year being required for construction. For "a detailed description of the work" the Canal Commissioners refer to the report of the engineer, W. E. MORRIS, and in that report, dated Nov. 1, 1839, we find the following:

The western division of the Pennsylvania canal is supplied by water taken by feeders from the Little Conemaugh river and Stony creek, which form a junction at this place. The valley of Stony creek is not well suited for a reservoir, as it has a steep descent, and in time of floods the stream is far too large and unmanageable.

The main branch of the Conemaugh has but one reservoir site on it, and that would flood the village of Jefferson and the railroad. Of the other branches, the *south* [the one adopted] is the only one that drains sufficient country to furnish a *certain* supply. This branch, when gauged in September, after one day's rain, discharged in 24 hours 60,000,000 cu. ft. of water. At the same time there were flood marks 2 ft. higher, and a *moderate* estimate of full discharge in 24 hours is 160,000,000 cu. ft. The best site for a dam is 2¼ miles from the mouth. A dam 62 ft. high and 600 ft. long on top, is suggested.

The valley is narrow at the dam and widens immediately above into an extensive basin. There is solid rock at both ends of the dam in which channels may be cut for flood water discharge. Drifts and shafts were sunk to insure in advance good foundations.

Plans for Dam.—Two were presented: (1) a crib dam of timber and stone with weir on top to pass over freshet water; and (2) a mound of stone and earth, made perfectly water tight, raised 10 ft. above the surface of the pool, having a waste weir in *solid rock* at one or both ends of dam.

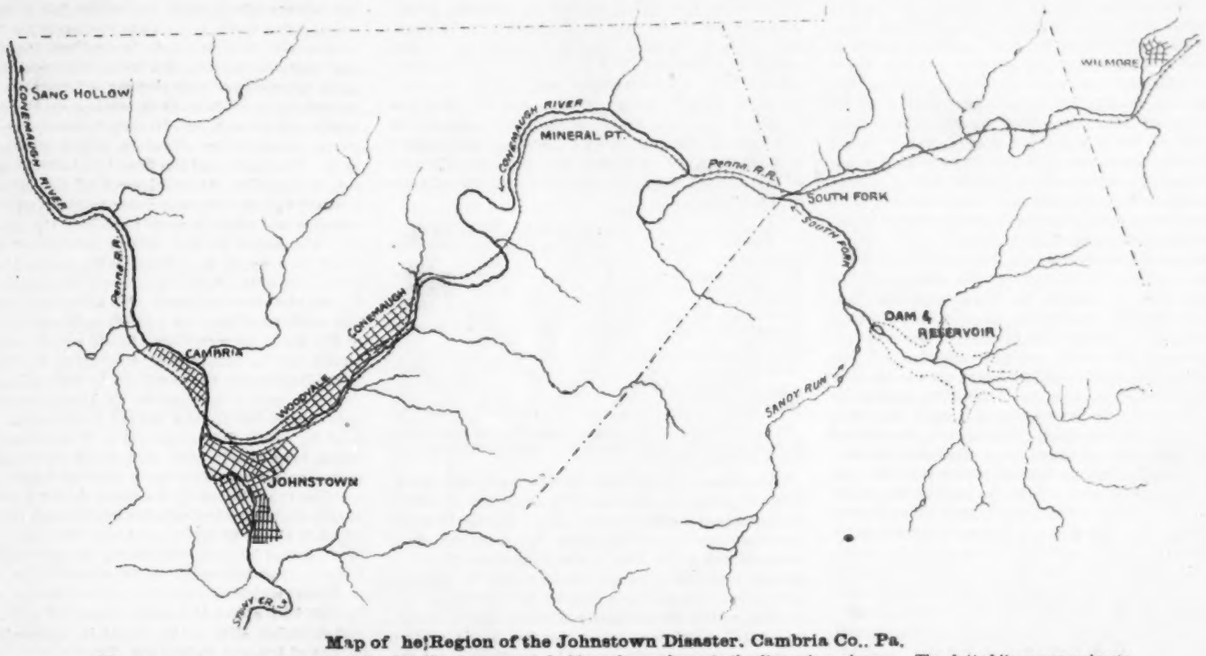
Mr. MORRIS then pointed out that there are serious objections to the first plan, especially difficulty in uniting the body of the dam with the embankment to prevent breakage under the pressure; danger of undermining base; perishable nature of material; constant repairs, etc.; and concludes that the second plan promises a permanent and durable dam, maintainable at small expense. He then presents the following estimates of quantities, showing a total cost of $188,000:

400	acres	clearing.
15,000	cu. yds.	found. excav. pud. ditches, etc.
40,000	" "	rock " in wastes.
110,000	" "	earth embankment.
100,000	" "	slate and stone embankment.
2,000	" "	puddling about sluice.
5,000	perches	cement rubble wall.
6,000	"	dry slope wall.

In the annual report of the Canal Commissioners ending Nov. 30, 1852, it is stated:

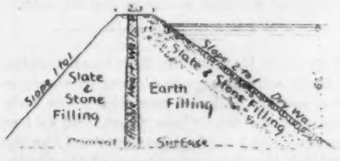
The western reservoir will be entirely finished in a very short time. . . . It has been constructed in a most substantial manner, reflecting great credit on the contractors and engineers in charge. The sluice gates were closed in June, 1852; by August the water was 40 ft. deep.

There had been some intermediate delay due to legal proceedings; but the dam appears, from the reports, to have been executed precisely according



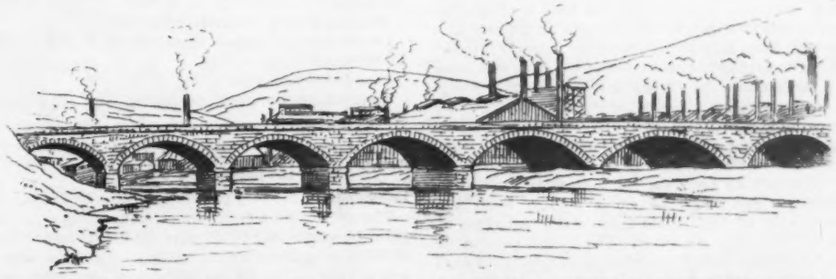
Map of the Region of the Johnstown Disaster, Cambria Co., Pa.

[From a county map published in 1867, when the old reservoir had been drawn down to the dimensions shown. The dotted lines approximate to the later dimensions of the reservoir.]



Approximate Sketch of the Section of the Original Dam on South Fork of Conemaugh river.

[This sketch is constructed from the description and quantities of material used, but is believed to be substantially correct.]



View of Penna. R. R. Stone Bridge at Johnstown, which resisted the flood and caused the jam of houses and human bodies.

to the original plans, which, from the quantities and some incidental notes, appear to have been for a structure closely resembling the accompanying sketch.

The dam was thus not completed until 1852; and after the abandonment of the State canal, soon after its purchase by the Pennsylvania Railroad in 1857, a breach developed in it, either suddenly or gradually, under circumstances not yet made wholly clear, except that they involved no serious disaster; probably by gradual abrasion of the normal water flow. The gap was about 150 ft. across at the top and extended down nearly to the bottom of the dam, yet still leaving enough of the old dam intact to retain a small remnant of the original reservoir. This gap is stated to have been closed and the damage repaired in 1879-81, at a total cost of $17,000 (the original estimated cost of the dam having been $188,000, as below detailed), a sum which would hardly be adequate to properly repair even a much smaller gap than this stated, not to speak of raising the original level; which latter would not only have been a rash and dangerous procedure, without reconstructing the dam complete, but would have involved a heavy expenditure of money, however rashly done.

The engineer in charge of the reconstruction of the dam is stated to have been the late Gen. JAMES N. MOREHEAD, in regard to whose professional standing and record we have no information. He was never a member of the American Society of Civil Engineers nor a subscriber to this journal, and is not known by reputation to us or to a number of well-informed engineers whom we have consulted. Nevertheless, he may of course have had an excellent professional record, and moreover, it seems tolerably clear that the primary cause of failure lay in no part of the work which he reconstructed, but in lack of sufficient spillway. The considerable leakage reported from the dam, however, would indicate that the reconstruction was none too secure, as would also its low cost, and it may well be that its lack of the substantial solidity of the old structure aggravated the disaster by aiding the dam to go out all at once instead of gradually. It is now forever too late to determine these facts with exactness, although further light may be shed on them by our pending investigation on the ground, or testimony at the official investigation.

The excessive and phenomenal rainfall, which is the second contributing cause of the disaster, and is more fully described below, began Thursday night, May 30, after several days of moderate prior rains, and continued almost till the dam gave way. The lake, although discharging its best through the contracted spillway, gradually rose, at the rate of a foot an hour, it is stated, for some hours before the break, implying that the crest of the dam was some 7 ft. or so above the normal level, as the old records indicate, until, at 2 30 P. M., of Friday, May 31, water began to run over the crest. The end then was certain, and could not be long delayed, no earth dam being capable of sustaining such discharge over it. It took half an hour for the increasing current to gradually cut away the earth support from the lower side of the rubble heart wall, and then, at 3 P. M., the dam gave way. The breach once made was doubtless instantly enlarged to nearly its final dimensions, 250 ft. across. In fact, some of the eye-witnesses state that it "burst with a report like thunder," which it is quite possible would have been the effect upon the eye and ear, even if the real course of events was gradual but very rapid disintegration in the torrent.

The above account corresponds most correctly with that given by intelligent eye witnesses of the break. A workman, who seems to have some grudge against the fishing company, absurdly declares that the dam had been leaking badly for weeks, and that on the morning before the disaster "jets squirted out for 30 ft. from the face of it," and that these leaks gradually and rapidly increased until the whole gave way, without any running of water over the top. This is so far consistent with other facts that the dam is known to have been leaking for several years past, and has been the subject of considerable apprehension, especially since the spring floods of 1888. The very fact that the dam is claimed by the company officers themselves to have been "inspected twice a month," by some engineers as yet unknown, tends to show that it was in a dubious condition, for a dam in good condition has no need of such frequent inspection; and it is also specifically reported that the dam was inspected by ROBT. L. HALLIDAY, Superintendent of the Lewiston & Sunbury Division of the Pennsylvania Railroad, "some years ago," and declared unsafe. But on the whole, the evidence is decided that it was the flow of water over the top of the dam, and not in any sense inability of the dam to sustain the static pressure of water, which caused the disaster.

The dam stands about 250 ft. above the town of Johnstown, the valley connecting it being about 12 miles long, counting all the bends of the channel, or about 10 miles long by the railway. In the valley were situated the following places, as shown on the large accompanying map, which we trace from a county map of the region that has so far escaped the notice of the daily press, which has been circulating divers highly inaccurate maps and sketches. We add also the census populations of 1880 and the estimated population of 1889 of each of these places:

Town or village.	*Dist. from dam by valley.*	*Population* 1880.	*Population est'd* 1889.
South Forks	2 miles	893*	2,000
Mineral Point	5 "	437*	800-?
Conemaugh	10 "	1,372*	2,500
Woodvale	11 "	637*	2,000
Conemaugh Borough	12½ "	3,498	30,000
Johnstown	12 "	8,380	
Cambria	14 "	2,223	
Intermediate county population		957*	400
Total to Penn. R. R. bridge		18,397	37,700

* These are township populations. The county being mountainous the population is very thin, apart from the valley in question.

The discrepancy between the 1880 and 1889 population is great, but it does not therefore discredit the estimated present populations. Rather it tends to authenticate them, for there has been an enormous growth since 1880 of the manufacturing interests clustered so thickly in the valley. It appears to us altogether probable that its population was on the day of the disaster fully 37,000, including Cambria City, which was below the fine stone bridge (rather imperfectly illustrated herewith in a cut reproduced from the newspapers) which withstood the flood, and was speedily so choked by drift and human bodies as to form a second dam to drown out Johnstown.

The fates which have befallen the above towns may be thus briefly summarized, according to the best information now at hand:

South Forks, no very serious results; a few drowned.

Mineral Point, "entirely wiped out."

Conemaugh, "almost depopulated," and every building swept away.

Woodvale, the same.

Conemaugh Borough, the same, but with more escape to the hill.

Johnstown } "The average opinion of a number of
Cambria } leading citizens is that 30 per cent. of the population is lost."

Intermediate country population, mostly drowned.

The above, when fairly considered, seems to us to point to a total loss of 10,000 at the lowest and about 15,000 or even 18,000 at the highest. The last accurate census of this region being now nine years old and worthless, and it being generally estimated that about one-third of the bodies, at least, will never be recovered at all, being burned up, buried under sand and detritus, or carried down the river, we do not see how it can ever be expected to determine the loss much more accurately than by the rude process we have just used; unless it may be by a census of the remaining population combined with an estimate based on the vote of the last Presidential election. An ominous and striking fact is that there seem to be painfully few survivors around, as we have elsewhere noted, a fact which becomes all the more ominous when we remember that they would naturally congregate about the scene of greatest destruction, and that 8,000 or 10,000 people standing around homeless and shelterless make an immense crowd and seem to be many more than they are.

That the chances for life of any one in the way of the flood after the dam had once given way were very poor, is evident when we remember that, as in all such cases, the flood advances, not with a comparatively shallow advance guard, but in a solid wall in front, which strikes a house or human being with terrible velocity, and directly downward rather than from the side. All accounts agree that the water did in fact advance, "like a wall 30 or 40 ft. high," and it is wholly in accordance with physical laws that it should do so, in fact it cannot well do otherwise. The water which first flows out, being retarded by the rough surface, trees, rocks, houses, animals, and other obstacles, speedily loses its own velocity, but furnishes an almost frictionless surface over which other water can slide, like ice down a plank, with almost the full theoretical velocity due to the fall. Thus the top of the flood is continually moving much faster than the bottom, and falls over the end of it when it reaches it, to be itself retarded and to surrender a large part of the energy due to its velocity in tearing up the ground and *beating down*, not driving forward, any unfortunate creature or structure which stands in its path. The bottom of the flood is relatively stationary, the top has its full theoretical velocity due to the fall, and the average velocity of advance hence becomes but slightly more than *half* the top velocity: the water, in fact, rolling over itself at the front very much as a wheel rolls, except that the lower part of the flood-wheel never rises again when it once strikes the ground. We have seen precisely this mode of advance on a small scale (say a "wall" 10 ft. high) in mountain, floods which were not caused by the bursting of reservoirs, but merely from cloud-bursts in the mountain tops miles away. The fall from the reservoir to Johnstown having been about 250 ft., the actual time taken by the flood to reach Johnstown (15 to 17 minutes) corresponds very closely with that which this theory requires, as we may show more in detail later; and it requires that the *top* of the water should have very nearly the theoretical velocity due to a fall of 250 ft., which is about 87 miles per hour: that due to the 160 ft. fall of Niagara Falls being about 70 miles per hour. Allowing for all the frictional losses, a man (or house) which sustained the *direct* impact of this torrent had about the same chance of resisting it and escaping alive as he would in sustaining the impact of Niagara Falls itself. The tendency which such a flood would have to bury many bodies is also evident.

The rain storm which caused the disaster, there is little doubt, was considerably the worst ever known in that region within historic times. Its cause had the same exceptional origin as that of the New York blizzard of last year. A storm center sweeping up from the Gulf, heavily charged with moisture, was met at the Alleghenies by a strong opposing current coming from the northeast, which acted as a dam to drive the gulf current upward, wring it of its moisture, and cause another such phenomenal downpour as is chronic at some points of India where the Himalayas serve permanently a similar purpose. Next week we shall endeavor to give further and more exact details of this storm. At present we must postpone the attempt.

THE NEW HAMPSHIRE RAILROAD COMMISSIONERS in their annual report discuss in a very common-sense way, the railroad war which has been in progress for the past three years, and call upon the companies and the legislature to end the strife, and establish the railway systems of the State upon a permanent and just basis. They favor strongly the consolidation of the various local roads with the Boston & Maine and the Concord systems, and say that unless this is done, the rapid deterioration of the railways of the State, and accident therefrom, are certain to result.

In the matter of accidents, particular stress is laid on the number of deaths due to trespassing on the right of way, and the report says:

Since September 30, 1885, 104 persons have been killed upon the railroads in this State, of whom 45 were employés of the road. Of the 59 not in railroad employe 27 were trespassers, most of them being pedestrians who were walking upon the track. During the same time but 12 persons have been killed upon crossings, and but 6 while coupling cars. From this it appears that more than 25 per cent. of all the fatalities we are called upon to investigate would not occur if people could be restrained from going upon the track when they have no right there, and that 27 persons are killed while trespassing as often as 12 lose their lives upon grade crossings and 6 when coupling cars.

The Eiffel Tower.

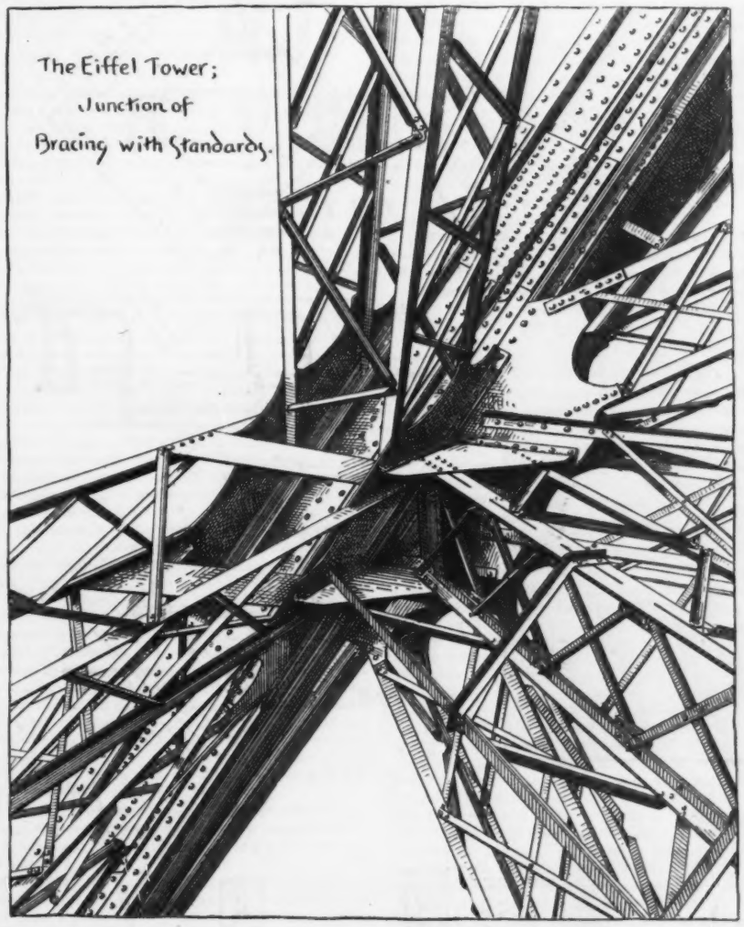
WITH INSET.

The illustration of the famous Eiffel tower presented in this issue is reproduced from a photograph of the finished structure sent to us from Paris, and consequently has the advantage over the multitude of constructed views that have already appeared, of showing it as it actually appears to the visitor to the Exposition, excepting only the buildings now filling up the base.

The best and most complete description of the tower that we have seen, especially in its illustrations, is the account given in the Exposition number of *Engineering*, and from this we condense the following general history of this remarkable feat of engineering skill and daring:

On Nov. 5, 1886, the Finance Committee of the Paris Exposition voted the sum of 1,500,000 f., or $300,000, as a subsidy towards the erection of the ower proposed by M. GUSTAVE EIFFEL. This famous constructor of bold engineering works was born in Dijon in 1832, and commenced the active pursuit of his profession in 1855. Among his more noted works may be mentioned, in the order of their sequence, the following: The foundations of the great railway bridge at Bordeaux, one of the early cases of the employment of compressed air; the bridge over the Nive at Bayonne, and two other bridges at Capdenac and at Florac. In 1867 he was associated with M. KRAUTZ in the construction of the large buildings of the Paris Exposition of that year; and in 1868, upon the lines of the Orleans Railway Company, he first adopted the system so consistently followed out by him afterwards of wrought iron braced structures as a substitute for cast-iron columns or masonry piers. A little later, in 1869, he introduced with great success the system of launching bridges out on their piers after erection on the ground in the line of the bridge. The Sioule viaducts were the first attempt at putting this system into practice, followed by the viaduct at Vianna, in Portugal, where iron girders, aggregating 1,800 ft in length, were so launched into position. Then came the viaduct of Tardes, near Montluçon, which was launched at a height of 328* ft. above the ground over piers 340 ft. apart. M. EIFFEL was the first of the French engineers to erect bridges without falseworks, by building out piece by piece; and his first work on this system was the erection of the 236 ft. span of the Cubzac bridge near Bordeaux. At Tan-an, in Cochin China, he erected in a similar way a bridge of 262 ft. span.

Of arch bridges built in the same manner as these just mentioned, his first great work was that over the Douro, at Oporto, the central span of which is 534 ft., the rise of the arch 138 ft., and the height of the rails above the water 200 ft. But this was surpassed by his greater work at the Garabit viaduct, where an arch of 541 ft. crosses the Touvère torrent, 400 ft. above it. Among later great engineering undertakings carried out by M. EIFFEL may be mentioned the Pesth railway station, the Szegedin bridge, the principal facade of the Paris Exposition of 1878, and the dome of the observatory at Nice, which is 75 ft. in diameter, weighs 100 tons, and floats in a circular trough so that the slightest effort will move it. The framework of our own statue of Liberty and the iron locks for the Panama canal are examples of the work of this engineer in this continent. From the foregoing, it is evident that M. EIFFEL came to his latest task on the tower well trained by previous experience in works of really greater engineering importance and difficulty than the monumental structure at Paris.



Eiffel Tower; Junction of Main Post and Bracing. From a Photograph.

The idea of a 1,000-ft. tower was not original with him. In 1833 Trevithick proposed such a tower in cast-iron, and in 1876 Clark, Reeves & Co., a well-known American bridge-building firm, proposed a tower of like height for the Centennial Exhibition. This tower was to be made of wrought-iron, with a height of 1,000 ft. and a base diameter of 150 ft. Finally, in 1881, one M. SEBILLOT proposed to light Paris with electricity from a tower 1,000 ft. high.

But the Eiffel tower as it stands is the outcome of a series of investigations undertaken by M. EIFFEL in 1885 with a view of ascertaining the extreme limits to which the metallic piers of viaducts could be pushed with safety; his special line of investigation had reference to proposed piers 400 ft. high with a base of 140 ft. The idea of the tower followed, and plans were worked out in connection with MM. NOUGUIER and KOECHLIN, two of M. EIFFEL'S principal engineers, and M. SAUVESTRE, the architect. As will be seen from an inspection of the plan, the tower is essentially a pyramid composed of four great curved columns, independent of each other and connected together only by belts of girders at the different stories until the columns unite towards the top of the structure. Iron and steel were used throughout.

The plans were completed in June, 1886; in the following November the subsidy was voted; and on Jan. 8, 1887, the convention was signed between the Government and the city of Paris fixing the conditions under which the tower was to be built. Actual work on the foundations was commenced in January, 1887. As we have already given considerable matter upon the erection of this tower, and as further detail would be useless here without the reproduction of a great number of drawings, we will only report some of the more general dimensions, etc., of this structure.

The base of the tower is a square with sides of about 330 ft. each, measured from main pier centers. The great arches in the base, which are merely ornamental, have a span of 243.5 ft. and a height to intrados of 129.2 ft. The height from the base to the various main stages is given on the general view presented. The bed-stones under the great piers are able to resist a crushing load of 1,600 lbs. to the sq. in., and as the maximum load which can be put upon them is 425 lbs. per sq. in., the margin of safety is ample. The total load upon each of the two foundations away from the river is 1,970 tons and the load on the masonry is equal to about 3 tons per sq. ft.

We reproduce from *Engineering*, Figs. 5-13, showing some of the foundation details, the most generally useful engineering feature of the work, though, indeed, almost every feature in the construction of this tower has more or less interest for the engineer. Fig. 5 shows the general location of the tower on the banks of the Seine, with the bridge of Jena crossing over to the Trocadero, the large building shown in the background of our illustration. Figs. 6 and 7 show the formation of the foundation soil. As shown in Fig. 10, there are four independent foundations at the angles of a square of about 330 ft., and each foundation is made up of four separate inclined piers, as shown in Fig. 11. The main foundations 2 and 3, nearest the Champ de Mars, are on a bed of gravel 18 ft. thick, with the top of the bed 23 ft. below the surface, and here the work was simply a 7.-ft. bed of concrete, which is all that was required. For piers 1 and 4, nearest the river, a different treatment was demanded. The bed of sand and gravel was about 40 ft. below the surface and 16 ft. below the mean level of the Seine, and it was overlaid by soft permeable deposits. Compressed air was used here, as shown in Fig. 13, and the foundations were sunk about 52 ft. below the surface before good bearing soil was found.

Figs. 8 to 11 show the details of these foundations. In the piers 2 and 3 the concrete base was in each case 32 ft. 9 in. long, 19 ft. 8 in. wide, and 6 ft. 6 in. thick, except in the central pier, where the base is 46 by 24 ft. to give a platform for the elevator machinery. The stone piers were built with a vertical face towards the center of the tower and with the opposite face inclined at the column angle; the other two faces are vertical and parallel. Fig. 12 is an enlarged view of one of these piers, showing the anchorage adopted, and is self-explanatory, though it may be said that the two anchor bolts are about 3.94 in. diameter and are placed 4 ft. 10 ins. apart on centers; they are built 20 ft. into the pier and pass through mooring-plates 8 ins. deep. These anchors are not necessary to secure stability in the tower, for this is maintained in position by its own weight

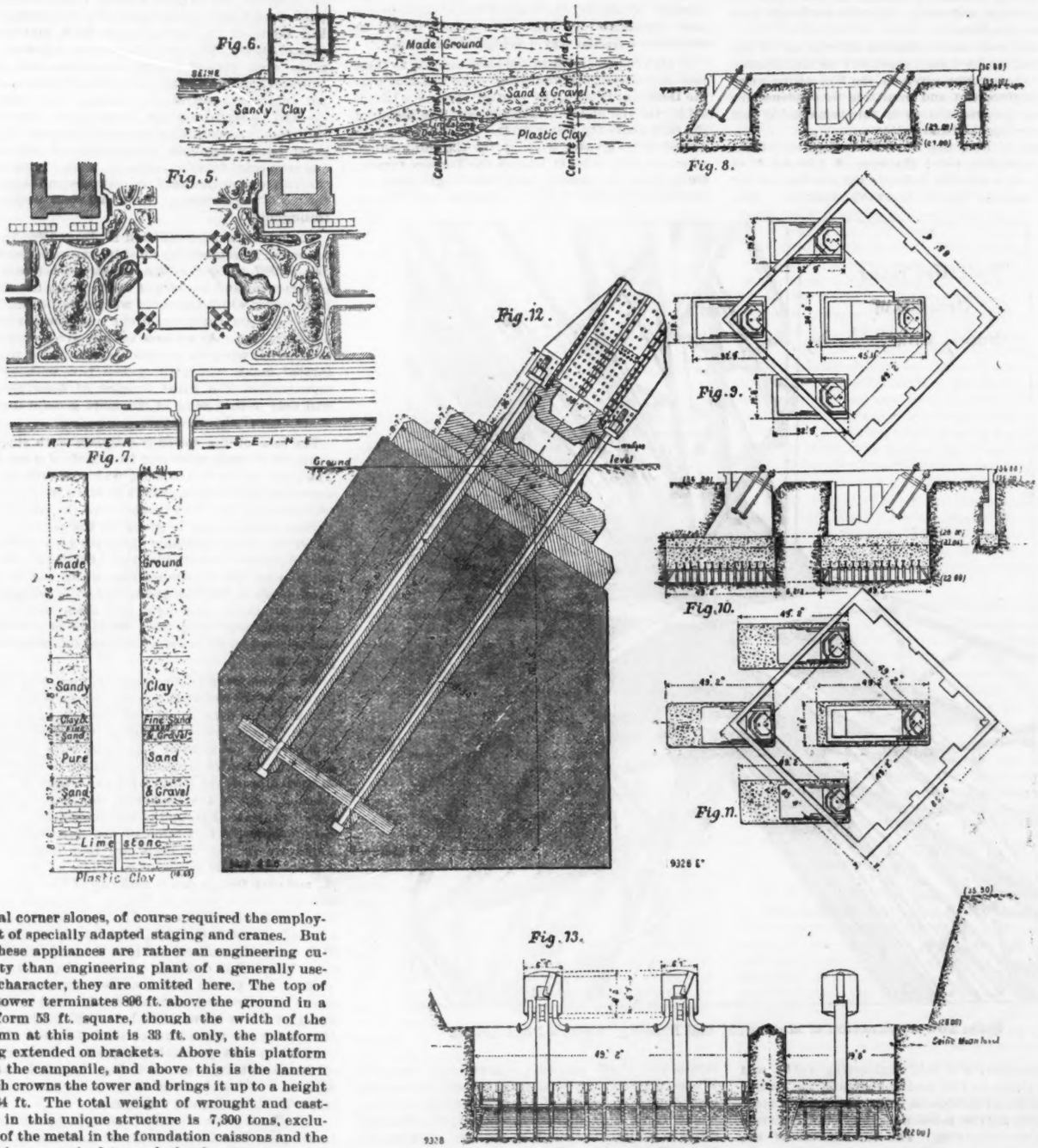
**Le Génie Civile*, in describing the wreck of the Tardes viaduct in 1884, says the distance from the surface of water to the rail is 301.2 ft.—ED. ENG. NEWS.

but it was considered advisable to use them, especially during the work of erection. The walls shown around the four piers in each foundation in Figs. 8 and 11 have no weight to carry other than that of some of the iron framework and mouldings which conceal and decorate the base of each main foundation.

The erection of this peculiar tower, with its steep initial corner slopes, of course required the employment of specially adapted staging and cranes. But as these appliances are rather an engineering curiosity than engineering plant of a generally useful character, they are omitted here. The top of the tower terminates 896 ft. above the ground in a platform 53 ft. square, though the width of the column at this point is 33 ft. only, the platform being extended on brackets. Above this platform rises the campanile, and above this is the lantern which crowns the tower and brings it up to a height of 984 ft. The total weight of wrought and cast-iron in this unique structure is 7,300 tons, exclusive of the metal in the foundation caissons and the machinery required to work the elevators.

The great tower is ascended by means of stairways and elevators. From the ground floor to the first stage, the two staircases are easy and comparatively wide, and one will be devoted to ascending, and the other to descending visitors; their estimated capacity is 2,000 persons per hour. Between the first and second stories a winding stairway 24 ins. wide is built in the center of each column, around wrought-iron tubes 15 ins. in diameter, and connected to the framework at intervals of 35 ft. by cross-girders. From the second story to the top of the tower is one spiral staircase 196 ft. high which is not open to the public. In the base of the tower the four great arches are occupied by buildings comprising an Anglo-American bar, a Flemish beer saloon, and a Russian and a French restaurant. The outer gallery, which runs around the four faces of the tower, is 8 ft. 6 ins. high and has an aggregate length of about 1,000 ft. with an area of 38,000 sq. ft. The second story has a surface of 15,000 sq. ft., and is surrounded by a gallery 8 ft. 6 ins. high with a length of 490 ft. The center of this floor is devoted to the elevator service. From the large hall on top of all a magnificent panorama, stretching around for more than 100 miles, will be visible.

There are a number of elevators, on three different systems. From the ground to the first story there are four elevators, of which two are of the Otis type and two provided by MM. Roux, Combalutier & Lepape; from the first story to the second the two Otis elevators pass on; and from the second floor to the summit is one Edoux elevator. It should be remembered that these elevators had to solve the unusual problem, not only of ascending but of traveling on a constantly varying inclined path, a problem which was successfully solved in each case. The Roux elevator carries 100 persons at a time with a speed of about 200 ft. a minute; the loaded weight of the car is 18 tons, including weight due to friction. The Otis elevators have a capacity of 50 persons each and travel at a speed of 400 ft. per minute; they are of the well-known American type of hydraulic elevators. The Edoux elevator travels over a height of 525 ft. by a vertical hydraulic plunger lift, carrying two balanced cages with a capacity of 63 persons, and at a speed equal to 750 persons per hour. The weight of each unloaded cage is four tons. Worthington pumps are employed for these Edoux elevators. The capacity of this elevator is equivalent to 2,350 persons per hour for the first and second stories and 750 persons per hour for the top platform. The total time occupied in ascending from the ground to the summit is 7



The Eiffel Tower; Foundation Plans, etc.

minutes. Including those using the stairways, 5,000 people per hour will be able to visit the tower.

This brief sketch of this important work may be concluded with a few miscellaneous items, as follows: The total weight of iron in the structure is 7,300 tons; the weight of rivets used is 450 tons, and the total number of the latter is 2,500,000. Of this number 800,000 were riveted by hand during erection. There are 12,000 pieces of iron of various forms, each requiring a special drawing. The total thrust on the foundation is 565 tons normal, and 875 tons under maximum wind pressure. The most careful observations were made from time to time as the tower was being erected, and these observations show conclusively that the foundations have not yielded under their load, and that no appreciable deviation exists from the vertical. M. EIFFEL says, and his assurance may be taken with confidence, that, under the most unfavorable conditions of wind pressure, the oscillations at the top will not exceed 6 ins. But one life was lost by falling from the erection platforms during all the work attending the building of this tower.

Iron Viaducts for Highways.

The growing necessity for overhead crossings of railways in the cities and large towns of the United States renders it important that the subject of viaduct designing receive more attention than has hitherto been given it. Bridge designing, in the true sense of the word, has become a specialty; but unfortunately, most of the highway bridges and viaducts built in this country show indisputable evidence that they are the work of inexperienced hands instead of that of experts. The reasons for this are not difficult to discover.

In the first place the preliminary study of the crossing and the lay-out of spans are made either by the city engineer or more probably by one of his assistants. Now, no matter how good a city engineer a man may be, unless he be thoroughly posted in the designing of ironwork, and unless he has made a special study of viaducts, the lay-out which he will determine will be both faulty and far from economical. The wasting of 25 per cent. of the material by a bad lay-out for a viaduct is no uncommon occurrence; moreover, even with such an unnecessarily large amount of metal, the structure is far from being sufficiently strong and rigid, owing to the want of adequate sway bracing, the arrangement of spans and columns often making it absolutely impossible to use proper bracing.

Next, the method of letting the contract is often a cause of very unsatisfactory results. Too often the work is advertised and thrown open to general competition upon very meagre data, viz., span lengths, widths of roadway and sidewalks, live load, and what is termed "factor of safety." Every highway bridge concern in the country is at liberty to bid in such a case; and as the contract generally goes to the lowest bidder, the chances are in favor of the work being taken by incompetent and irresponsible parties. These parties usually entrust the detailing of the structure to draughtsmen who receive salaries not exceeding $100 per month. It is preposterous to imagine that such men are capable of successfully grappling with and solving some of the most intricate problems that occur in engineering practice.

Many who read this will exclaim, "But the designing of a highway viaduct does not involve any complicated or difficult problems of engineering: it is a comparatively simple matter."

There is where the mistake is made! The writer can conscientiously state that the complete designing of a viaduct upon a grade (as is generally the case), crossing railroad tracks at various angles, most of the spans being on the skew, and seldom two skews being alike, the railroad tracks having different elevations, with the distance from floor-surface to clearance line below to be kept at a minimum, and the matter of longitudinal and lateral expansion and contraction to be properly provided for, involves the employment of as much care, patience, technical training, judgment, ability, and experience as will almost any problem to be met with in engineering practice.

Even if tenders be called for upon standard specifications, and bidders be required to submit their own strain-sheets and preliminary designs, unless an expert be employed to award the contract, the work is very likely to go to irresponsible parties, who have submitted designs that do not come up to the requirements of the specifications. As a rule, highway bridge builders are not accustomed to making plans according to first-class specifications. Then, when, later on, the working drawings are submitted for approval, it requires an expert to pass judgment upon them.

The choice of standard specifications will affect to a greater or less extent the cost of a viaduct. For instance, when a road roller is specified as one of the rolling loads, the cost is immediately increased. In the opinion of the writer, it is a piece of extravagance to specify a road roller load for any viaduct excepting those for very large cities. If a road roller be occasionally taken across a well-designed viaduct that was computed without using the road roller load, no harm will be done: the floor and primary truss members will be a little overstrained, that is all. But road rollers are not in general use, except in very large cities; so it would be better to prohibit their transport over viaducts, unless they be uncoupled and carried over piecemeal, rather than to make all viaducts unnecessarily expensive. These remarks concerning the use of the road roller in designs, apply with special force to structures for Western cities.

Again, certain specifications prohibit the use of webs less than ⅜ in. thick for floor beams, iron joists, and plate girders, while it is a well-known fact that ¼-in. webs, when properly stiffened, will answer the purpose just as efficiently in every particular.

When ⅜-in. webs are used very generally for railway bridge stringers, why should a minimum thickness of ⅜ in. be insisted upon for webs of beams and joists in highway bridges? It may be stated in reply to this that the extra ⅛ in. is to provide for rusting out; but, if so, why provide for rusting only in webs? In other parts of the structure the limiting thickness of iron is ¼ in.

Can any one point to a case of even incipient failure in a *properly designed* girder having a web ¼ in. thick? In a viaduct with iron joists the use of ⅜-in. webs throughout will alone add a large percentage to the cost of the structure.

There are other excessive requirements called for in standard specifications, but these requirements are seldom lived up to *in toto* in designing, consequently it would be far better to omit them altogether.

In designing viaducts the element of rigidity seldom receives due consideration. A structure that vibrates unduly is a structure that is overstrained, even if the calculations for statically applied loads show an excess of section in every member. What does excessive vibration indicate? Does it not show that certain members are extended and compressed to a greater amount than is legitimate, and is it not well-known that extension and compression cannot ordinarily occur without inducing stress, and that the greater such extensions and compressions the greater are the accompanying stresses?

For instance, if in the case of an elevated railroad, on account of an insufficiency of longitudinal bracing, we see the whole structure vibrating longitudinally for a quarter of a mile ahead of the train, cannot we conclude that the metal in the unsupported columns is likely to be overstrained?

When one thinks of how little extra metal it takes to efficiently brace a viaduct, and of the great improvement that such bracing effects, one cannot help exclaiming, "Why in the name of common sense do bridge designers ever fail to duly consider such an important matter as this?"

Many of the viaducts that are being built at present in the West are full of faults of design—not only faults due to ignorance, but also those due to culpable wilfulness and dishonesty.

That no two engineers will agree exactly concerning the merits of even the best of designs is perhaps a fact, and it is to be expected that any expert, in examining such a set of plans, will find one or more points where he would suggest changes, because each expert has his own individual notions concerning certain requirements that are still unsettled by the profession. But this is no reason why, in examining an ordinary set of plans for a viaduct designed, or supposed to have been designed, according to certain standard specifications, a bridge specialist should feel compelled to make changes that fundamentally modify the entire character of the structure, and in reality necessitate the preparation of a new set of drawings.

Such has been the writer's experience on more occasions than one, consequently he knows whereof he speaks.

In addition to the previously mentioned faults of design, the following are of common occurrence: The unnecessary use of skew spans, incorrect location of pedestals transversely to axis of structure, failing to provide properly for effects of changes in temperature, using short pin-connected spans, omission of struts just above pedestals in both transverse and longitudinal bracing, employing heavy cast-iron sockets for the purpose of fixing the lower ends of columns, using cast-iron bed-plates, failure to proportion columns for bending due to wind-pressure when an incomplete system of sway-bracing is used, failure to provide for the horizontal shear in the same case, making beams and girders fish-bellied from false motives of economy, failing to stiffen the iron hand-railings, attaching sway rods in such a manner as to produce a torsional effect upon other members, subjecting rivets to direct tension, making lateral struts too narrow for rigidity, using very shallow iron joists, and employing bent eyes on lateral rods.

The evils resulting from the above mentioned faults are as follows:

Skew spans are not only more difficult to design properly, but are troublesome to put through the shops, therefore the pound price for the ironwork is greater than for square spans; besides, the amount of metal required is greater. Moreover, a skew span cannot be made as rigid as a square span, and the expansions and contractions of opposite trusses at any particular point are unequal, consequently a skew design is never quite satisfactory.

In case of through spans, there is no option about where to locate pedestals in a plane transverse to the axis of structure, but in deck spans (and viaducts, for several very good reasons, should be deck structures) there is one position for the pedestals that will give a greater economy of material than will any other, which position should, in the absence of sound reason to the contrary, be adopted.

Unless adequate means to provide against effects of variations in temperature be arranged for, temperature stresses of serious magnitude will be induced; and when such stresses exist, something generally gives way.

Short pin-spans are always objectionable, owing to lack of rigidity. Moreover, for economy of material (the sole excuse for using them) a greater truss depth is required than the governing circumstances will allow, unless through spans be employed.

It is now in order to state the objections to through spans, especially short ones, for viaducts.

1st. Viaducts nearly always have cantilevered sidewalks, which will prevent the use of side braces for stiffening the top chords of pony trusses.

2d. The use of deck spans in a viaduct almost always directly or indirectly effects a saving in cost.

3d. For a certain fixed clear roadway and fixed widths for sidewalks, the through span will necessitate a greater total width out to out of structure than will a deck span.

4th. As in nearly every viaduct there are some deck spans, the appearance of the structure is marred by the combination of deck and through. This in certain cases, such for instance as where a number of railroad tracks have to be cleared by a single span, is unavoidable, consequently in those cases the appearance has to be sacrificed.

The omissions of longitudinal and transverse struts just above the pedestals in towers is decidedly a bad feature; for in cold weather the sway rods, reaching almost to the feet of the columns, contract, and draw the pedestals together; then when the temperature rises, the friction on the masonry prevents the latter from regaining their old position. The result is that the sway rods hang in festoons, and the pedestals rest merely on their outer edges. The writer once saw an excellent example of this where cast-iron shoes were used for bearing upon the masonry. In certain cases, there were pieces of the casting broken off, owing to the load having been carried by one edge of the shoe.

Heavy cast-iron sockets bolted to masonry piers cannot truly fix the ends of columns, unless the latter fit inside them absolutely without play. This, of course, is impracticable, hence no attempt is made to fit them, but the sockets are filled with some kind of cement after the columns are erected. An examination of this connection will often show that the cement filling has been slightly crushed where it touches the column, leaving a perceptible space between. This space is objectionable, not only because it will hold moisture and rust the iron but because its very existence shows that the object of employing the socket has been defeated, and that the ends of the columns are not fixed as supposed.

Cast iron, if enough of it be used, will, with proper precaution in making the design, answer well enough for bed-plates; but it is much better not to employ it, as it really effects no true economy.

Incomplete systems of sway bracing, both longitudinal and transverse, are often rendered necessary by the requirements of the location. The land under the viaduct is often too valuable to permit the adoption of complete towers under alternate spans (which is not only the scientifically correct method of designing, when it can be used, but also the most economical), and not unusually there will be a street under almost the entire length of the structure. In such cases it is evident that the sway rods cannot reach near the ground, but that the lowest part of the bracing must be high enough to give whatever clearance is required, which is generally about 14 ft. The total wind pressure upon the structure is divided in some manner or other between the total number of pedestals. There will be then a horizontal thrust at the foot of any column which is incompletely braced. The effect of this thrust is to produce a bending on the column that will usually demand an increase in its sectional area, even when the intensity of the working stress on the metal is considerably increased, which is perfectly legitimate. This bending effect does not cease when the bracing is reached, but extends in diminishing amount to the top of the column. An analysis of the effect of such bending is quite interesting, but would be out of place in a paper like this. Any one desiring to investigate the subject mathematically would obtain valuable aid by reading that portion of BURR'S "Stresses in Bridge and Roof Trusses" relating to "sway bracing." It is treated

* A paper presented to the Engineers' Club of Kansas City, by J. A. L. WADDELL, Consulting Bridge Engineer, Kansas City, Mo.

also in the writer's work on highway bridges. In neither treatise, however, has the subject received the complete investigation of which it is susceptible, although Prof. BURR's analysis is both elegant and thorough.

The usual method of computing the stress in a sway rod belonging to an incomplete system of bracing is to multiply the horizontal thrust at the top of the bent by the secant of the angle which the sway rod makes with the horizontal; but any one who will investigate the actual conditions of stress, as outlined by Prof. BURR, will see that the true stress will be from two to three or even four times as great as that found by this incorrect method.

The horizontal thrust passes from the pedestal to the bracing and causes a shear on that portion of the column below the bracing. It is not advisable to let this shear be taken up by one or two systems of lacing bars; because, if there be one imperfect rivet hole in the lacing bar, the system will be rendered inefficient. The proper detail to employ is a diaphragm attached by four angle irons to the rolled or built channels of which the column is generally composed; then, if there be an imperfect rivet or rivet hole, the continuity of the diaphragm will carry the shear. This is a point that has generally been overlooked. The writer's attention was called to it not long ago by a well-known bridge engineer of Kansas City.

By adopting the Strobel or Z iron column, and using a continuous web instead of lacing, both the bending and shear can be effectively provided for. This section has not yet come into general use, perhaps because its manufacture demands special care to prevent the columns from being bent and twisted. It is a good column, however, and is sure to be generally adopted sooner or later.

Fish-bellied girders are occasionally desirable to meet some special requirement, but the idea of using them as a means of saving metal or expense is a fallacy. To begin with, the metal saved from the web is not of sufficient value to compensate for the increased cost of manufacture; then again the diminished depth of the web at the ends of the beam will often fail to give space for the requisite number of rivets to take up the horizontal shear; but these are not the true objection to the use of fish-bellied girders. Mr. A. P. BOLLER has shown by a very interesting test to destruction of a full-sized fish-bellied beam, that there is a weak point where the angle of the flange occurs. To reinforce this point and make it as strong as the rest of the piece would require about as much metal as is saved by the bevelling off of the web to say nothing of the extra trouble in the shop work. The result of Mr. BOLLER'S experiment proves that it is always better to avoid using fish-bellied girders of all kinds wherever practicable, and that, when they have to be used, special care ought be taken in their designing.

It is assuredly false economy to put a light iron railing on a first-class structure; much more then is it objectionable to fail to provide with adequate side bracing whatever hand-rail is adopted. It is not enough to fasten the hand rail posts at bottom: there should be a stiff triangular bracing frame to take hold of the top of the railing at every ten or twelve feet of its length.

Attaching sway rods or any other pieces in such a manner as to produce torsion upon any portion of a structure shows that the designer does not comprehend even the elementary principles of the science of design, for the effect of torsion is never provided for in bridge building. The writer has, however, seen struts twisted very perceptibly by merely screwing up the lateral rods. It is true, though, that the structures containing this feature were built several years ago.

Subjecting rivets to direct tension and relying thereon must be deemed really culpable, when one considers that the initial tension on the stems of rivets due to cooling is sometimes sufficiently great to force off the heads.

Making lateral struts too narrow for rigidity is a very common fault of highway bridge builders, and is the result of the pernicious system of throwing open ironwork to unrestricted competition. The ratio of length to least dimension of a lateral strut should not exceed 45.1, and the ratio of its length to its least radius of gyration should not exceed 150.1. What a difficult thing it is to convince those who have anything to do with the building of highway bridges and viaducts that rigidity is as important a consideration as is strength!

Iron joists are, on account of their cost, employed only in what are considered first-class bridges and viaducts; nevertheless their depth is often such as to cause the setting up of excessive vibration, which must be injurious, not only to the joists themselves, but also to many other important members of the structure.

The writer once lost the contract for an important bridge in competition, principally because the engineer in charge of the letting allowed the successful competitor to use 9-in. rolled I-beams for joists 25 ft. long, which had to support a floor carrying a cedar block pavement. Many people who pass over this bridge consider it unsafe because it shakes to such an extent; while in fact there was even more iron than necessary used in the structure. Those joists should have been preferably 20 ins. deep. By adopting thick flooring it would have been legitimate to space them 3½ ft. apart instead of 2 ft. as was required, thus involving the use of very little more metal, if any, and adding greatly to the efficiency of the structure.

Far worse cases than this have at times come to the writer's notice. Springy joists cannot be expected to support blocks in a pavement so that they will not tend to work loose.

The great objection to bent eyes on lateral rods is that the detail cannot by any possibility develop the full strength of the rod. Years ago the writer used them, but he is better informed to-day.

Modern general specifications for bridges and viaducts provide for the use of steel; nevertheless, in the writer's opinion, it is not good practice to employ steel in designing viaducts merely in order to save weight of metal. In long spans and large heavy work, such an economy would be legitimate; but in light work, like ordinary highway viaducts it is not right to cut down the weight of metal to the lowest possible limit. Even when properly designed, and iron only being used, it is not improbable that the structure will be lighter than is advisable Moreover, steel, though stronger, is no stiffer than iron consequently, if we cut down the sections by usin higher intensities of working stresses, we shall increas the vibration under load.

One important factor of true economy in design consists in employing a few large heavy pieces, instead of greater number of smaller ones; for even if the total weights in both cases be the same, the small number of pieces will reduce the cost of manufacture and erection.

The economic arrangement of span lengths is so complicated a problem that it will be better not to attempt any general solution, but leave the study of economic lay-out to be made by a bridge expert for each case as it arises.

Among other considerations that affect this investigation are the following: Value of the land covered or crossed; city requirements as to vertical and horizontal clearances; height of viaduct; comparative cost of masonry and ironwork; style of floor system proper—whether of wood or iron; peculiarities in the specifications adopted; the width of roadway, which will determine whether two, three, or more lines of main girders will be used; difficulties that may be anticipated as likely to arise when building piers; method of erecting ironwork; architectural effect; limiting distance between surface of floor and lowest portion of spans; the necessary provision for expansion and contraction; capacity of soil to resist pressure from pedestals; danger of the earth sliding when building on a side hill; the possible necessity for using piles under pedestals, and their probable duration; and last, but by no means least, the amount of money available for building the viaduct.

When the adoption of spans exceeding 80 or 85 ft. becomes a necessity, these spans should be made pin-connected; and, if the clearance beneath be limited, through spans will have to be employed. Plate girders ought to be used for spans up to 40 ft., or more if the item of cost be not a very important consideration. Between the plate girders and the pin-connected spans, triangular riveted, or, as they are often termed, lattice girders should be employed. The use of more than one system of cancellation in lattice girders cannot be too strenuously opposed; for in the best-designed riveted girders, there is enough unavoidable ambiguity of stress distribution without unnecessarily increasing this objectionable feature.

In general it may be stated that rigid lateral or sway bracing is preferable to the adjustable, nevertheless the latter is oftentimes so much more convenient that its employment is not merely legitimate but advisable. Adjustable rods, though, should be provided with effective check nuts, so as to prevent them from getting out of adjustment.

High viaducts and those with narrow roadways will require battered columns, but the ordinary city viaduct is so wide and so low that vertical legs can be used. There is quite an advantage in making columns vertical in that it simplifies the detailing. The batter should vary from 1 to 2 ins. to the foot, or even in extreme cases to 2½ ins. The amount of batter necessary can be determined by figuring the overturning effect of the maximum wind pressure upon the unloaded structure, under which circumstances there should be but little, if any, tension in the windward columns. Under very exceptional circumstances, however, it would be proper to allow a certain amount of column tension, and provide for it adequately in both superstructure and substructure.

Anchor bolts should be let into the masonry far enough to insure their breaking before moving any of the stonework in case of testing to destruction. Ordinary anchor bolts are insufficient to resist anything except shear, as they penetrate but a very short distance into the masonry.

Spans in viaducts should never be made continuous over the points of support; because, if any settlement should occur, the girders would be overstrained. Moreover, there is no true economy in continuous spans, even though calculations prove a theoretical saving of material.

Rocker bents are often rendered necessary in viaduct designs by the impracticability of employing braced towers. Their adoption is to be avoided when possible, for they do not make as rigid a structure as do the towers. Special care is required in designing the pedestal details in order to carry the wind pressure from the ironwork to the masonry without overtaxing any of the metal.

The sizes of bearing plates on masonry are to be determined by what is considered to be a safe intensity of pressure for the latter. The amount will vary from 650 lbs. per sq. in. and for granite to 200 lbs. per sq. in. or even less for limestones and sandstones. The loads producing the pressure are the combined live, dead, and wind loads. The latter is often a very important factor. Pedestal plates should be proportioned for an assumed uniformly distributed load over their entire lower surface, and the bending effects of this load on all parts of the detail should be properly provided for. Pedestals are too often proportioned without any calculations whatsoever, excepting perhaps those for pin bearing.

Wooden joists should vary in section from 3 x 12 ins. to 4 x 16 ins., or in extreme cases of panel length 4 x 18 ins.; and the spacing between centers should vary from 24 ins. to 18 ins., or even 16 ins., according to the panel dimensions, maximum load assumed, and formula for proportioning. Deep joists are preferable to shallow ones in that they spring less, but there is a limiting ratio of width to depth. It is proper to use 3 x 14-in. sections, although 4 x 14-in. ones would be preferable, while 3 x 16-in. ones ought never to be allowed. Bridging joists is an economic expedient that ought not to be tolerated in good practice. It is an open confession that the joists are too narrow for their depth. Moreover, bridging will not accomplish the desired object, for the reason that the bridging pieces, being insecurely fastened, are pretty sure to work loose. Joists narrower than 3 ins. are liable to be split by the spikes. In the writer's opinion, pine joists are better than oak ones, because of the tendency of the latter to warp and twist. In the near future Oregon pine will probably be extensively used for joists. It is stronger, stiffer, and in every particular better for the purpose than oak.

Where viaducts are to be paved, deep joists should invariably be used; they can be spaced farther apart than usual, if 4-in. flooring be employed. Iron joists under paved flooring should be of built sections instead of rolled, in order that the greatest possible depth with a certain sectional area may be obtained.

Guard rails, as a rule, are placed too near the parts of the structure which they are intended to protect. They should be at least 2 ft. therefrom. On down grades the guard timbers should be protected by iron facings, because the drivers of heavy vehicles are apt to use the guards instead of brakes to prevent their descending too rapidly.

The adjusting of the grades on a viaduct is often an important matter, and should not be done without considerable deliberation. The heavier the grade the shorter will usually be the viaduct, and consequently the less will be the cost; but, on the other hand, the heavier the grade the smaller will be the loads that can be hauled up it. To determine the maximum grade for any structure, the following points will have to be considered:

(1) What is the character of the traffic that is sure to occupy the structure immediately after completion?

(2) What are the chances of the character of the traffic being changed in the immediate or distant future?

(3) What is the ruling grade in the city which teams crossing the viaduct with heavy loads will have to surmount?

(4) In which direction will be the heavy traffic?

(5) How does the length of any assumed maximum grade on the structure compare with the length of various heavy grades in the city which will have to be surmounted by teams using the viaduct?

(6) How much money can be spent upon the structure, or how much money is it advisable to spend thereon to anticipate future requirements?

The designing of pedestals for columns is a matter that demands careful study and consideration; for, on the one hand, if the amount of the appropriation be small, there will be a temptation to use insufficient foundations, while, on the other hand, an inexperienced engineer, in order to be upon the safe side, is very apt to waste a good deal of money on unnecessary masonry. It requires considerable experience to determine the advisable extent to which various kinds of soil should be loaded, and when piles should and when they should not be used for foundations.

The designing of railings demands not only good judgment, but also good taste. Their weight per foot will depend upon the duty required of them, whether they be intended to prevent horses from leaving the roadway, or whether their object be to withstand the pressure of a crowd of people. In both cases, however, they should be most effectively braced.

In the writer's little pamphlet entitled "General Specifications for Highway Bridges of Iron and Steel," will be found all the rules and specifications needed by a good bridge designer to enable him to proportion all parts of any viaduct.

For all ordinary cases it would be well to design according to the specifications for "Class B," using those for "Class A" only in the case of a viaduct for a large city where the traffic is both heavy and incessant.

In preparing these specifications the writer had in view not only the requirements of good engineering practice, but also the interests of those who will have to pay for the structures. His loads in some cases will be found to be less than those given in certain standard specifications, but it is his opinion that the latter demand more than is really necessary, and that if the loads that he specifies be provided for thoroughly in every particular in the manner which he indicates, all the elements of a good structure will be obtained.

And now in conclusion a few words as to how the contract for a viaduct should be let, in order that the parties who furnish the money may obtain a structure which will answer all reasonable requirements at a minimum cost. The first step to take is to call in consultation a specialist of acknowledged reputation so as to determine what are the necessities of the case, and what kind of a structure it is advisable to build; the next, if time presses, as it generally does in this country, is to have this specialist prepare a general plan and elevation of the proposed structure together with diagrams of stresses and sections, a sufficient number of sketches of details to illustrate the general character of the design, an approximate estimate of the quantities of the various materials, and complete specifications, then call for bids upon schedule prices, limiting the shipping weights of metal to a variation of 2 per cent. from those called for by the strain sheets and detail drawings, allowing only reputable builders to bid, and awarding the contract to the bidder whose tender, everything considered, appears to be the most favorable to the parties who pay for the work. The next step is to have the specialist prepare detail drawings so complete that all the dimensions of every portion of the structure will be accurately determined, said drawings to comply in general with the specifications and the preliminary drawings; the next is to engage a competent and trustworthy inspector to follow the iron through mills and shops to see that the quality of material and workmanship be as good specified; the next is to engage a competent and reliable superintendent to look after the erection and see that all the work of both substructure and superstructure be done in strict accordance with the specifications, both inspector and superintendent reporting to the specialist who prepared the designs; and the final step is to have the latter examine the completed structure so as to officially accept it before the contractor be paid in full for the work.

In this manner, and this only, can either a community or an individual make sure of obtaining a properly designed and properly built viaduct.

If the work be let by the pound to a bridge company upon their own design, the weight is very likely to be excessive; while, if it be let for a lump sum, the structure will often, in consequence, be deficient in strength and rigidity. Human nature is human nature the world over, and if anyone thinks that a bridge company is going to take the work in keen competition, and then present gratis to the community a lot of material or work, he is very much mistaken.

Arch Culvert and Steam Shovel Work, I. D. & S. Railway.

The following very practical paper by Mr. E. D. HILL gives an account of the construction of a comparatively small structure, which we wish were more often paralleled in its thoroughness, especially as respects dollars and-cents details, by papers on more ambitious structures. The record of steam shovel work in filling over the structure is also especially interesting; and the way in which the mouth of the structure is shaped, without the usual sharp shoulder, is a detail which has been often commended in these columns, and which ought to become universal. We believe it was first brought to the attention of engineers in a public way by the editor of this journal, but it by no means originated with him, and he regrets to say that he does not know with whom it did originate, as individual structures have been built in that way for a long time; nevertheless, it has not been and is not yet general, owing largely, we believe, to the supposed awkwardness of intersecting neatly a battered wing with a vertical abutment wall. The late disaster should impress more forcibly than ever on the minds of engineers that no detail which gives a percentage of additional safety to structures can properly be neglected, on the assumption that it is "strong enough anyway;" and if this be remembered, the absurdity of introducing a sharp shoulder at the mouth of culverts, to catch driftwood, decrease the discharging capacity of the orifice, and increase the cost of the masonry by eight needless sharp corners on each structure, becomes at once apparent. We are disposed to believe that a circular arc of 120° or thereabouts is better and more economical than a semicircular arch for such structures, but that is a matter of opinion. We slightly abbreviate the paper as follows:

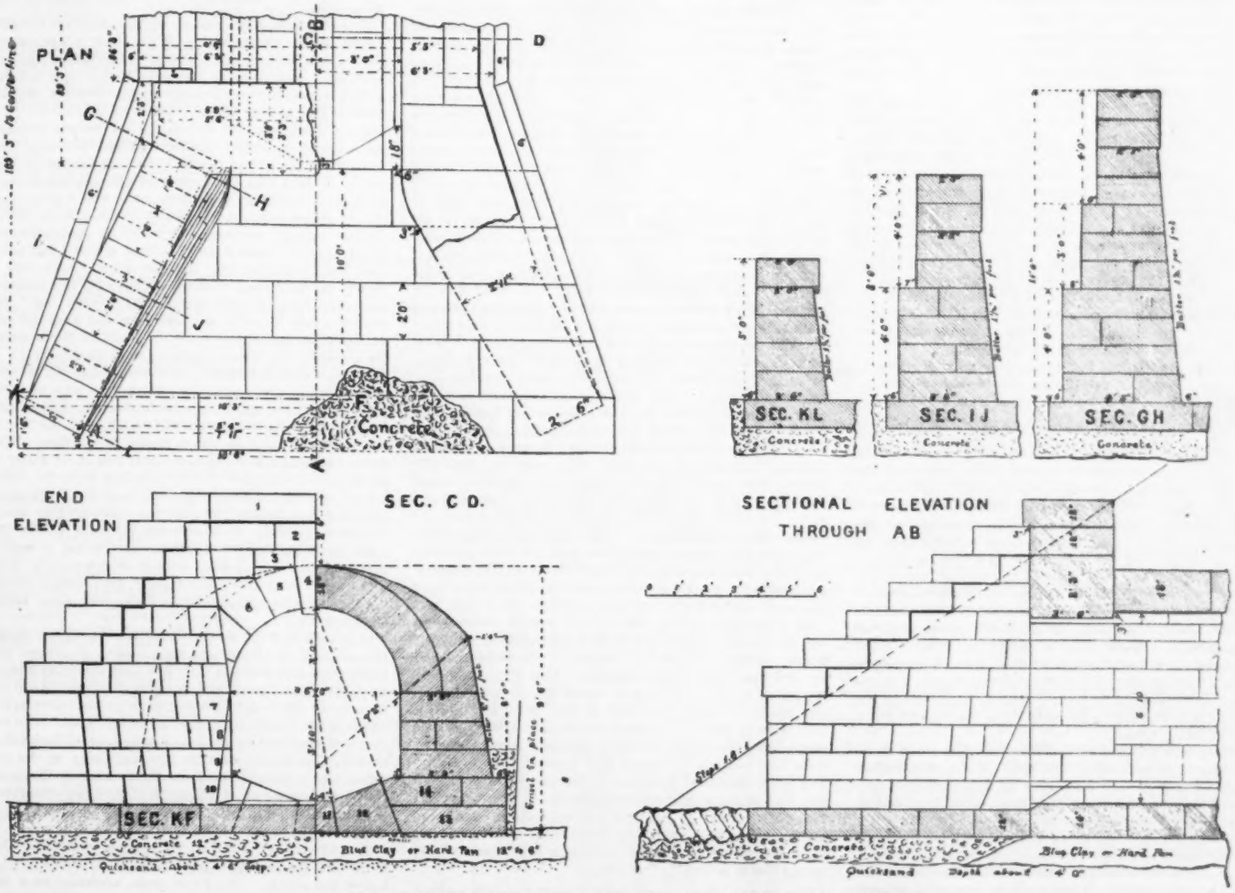
In Putnam Co., Ind., between Raccoon and Russellville, the Indianapolis, Decatur & Springfield Ry. crosse Nichol's Hollow on a three-story wooden trestle about 450 ft. long and 67 ft. high, with 18 bents, spaced generally 25 ft. center to center, the location being on a 3° curve.

Two years ago the question of renewal came up. The question presented itself in about this shape:

PLAN 1—Estimated cost of a new wooden trestle	$6,000
PLAN 2—Cost of 75,000 cu. yds. earth filling at 10 cts	$7,500
Cost of 465 cu. yds. culvert masonry at $7.00	3,255
Total cost	$10,755 $10,755
PLAN 3—Estimated cost of an iron trestle	$15,000

Assuming annual renewals to the wooden structure at a minimum of 10 per cent. on first cost, and capitalizing this annual charge at 6 per cent., gives a capital of $10,000, so that in this respect plans one and two compare closely with each other. Our management, however, were willing to incur considerable extra expense, if thereby they could secure good and substantial work, and were as willing to adopt the plan of an arch culvert and an earthwork embankment. Ten cents per yard for earth filling may seem pretty low, but we based our figures on past experience.

We had a spur track into a good sandstone quarry about two miles from the work, and we accepted an offer of dimension stone at $1.50 per yard loaded on the cars and measured in the work, which was very deep. The stone in some respects resembled the Berea stone of Ohio. It quarries in blocks of large size without flaw or seam, is at first soft and easily worked, but hardens by exposure. Large sized samples, tested at our shops, showed a quite uniform crushing strength, averaging



Six-Foot Arch Culvert, Indianapolis, Decatur & Springfield Railway.

* Abstract from Proceedings of the Illinois Society of Engineers and Surveyors.

about 250 tons per sq. ft., rather lower than Berea stone, but still strong enough.

The original plan called for a semicircular arch about 200 ft. long, 6 ft. span, area of waterway about 32 sq. ft., on a grade of 15 ins. per 100 ft., which by Trautwine's formulæ and tables (Edition 1885, pages 274 and 276) indicates a carrying capacity of 442 cu. ft. per second or about 13.8 cu. ft. per second per square foot of area of opening when flowing full.

When built, the opening was increased to about 35 sq. ft. of area for reasons explained hereafter, corresponding to a maximum capacity of about 485 cu. ft. per second and sufficient for a rain-fall of 3¼ ins. per hour by Trautwine's formula, C being taken equal to 0.3, but for a rainfall of only 1½ ins., by the formula of the culvert pipe makers (assuming their data to apply to such large areas) and corresponding to the assumption in Myres' formula of

$$\text{Area in sq. ft.} = C\sqrt{\text{acres drainage area}}$$

when $C = \frac{1}{4}$, which is lower than any value advised by him.

Sixteen hundred acres, however, was probably in excess, and several years' observation by the road department, had failed to discover more than from 12 to 15 sq ft. of cross section passing in times of highest water, and as the structure could probably run under a considerable head for a reasonable time without injury, I saw no reason for adopting larger dimensions.

I would suggest as a practical method of culvert proportioning that observations be made at the given locality to determine for a known amount of rain-fall per hour the corresponding depth of water at its highest stage. Observations of a few storms would probably show a nearly uniform ratio existing between the volume of water passing and the inches of rain-fall per hour. We could then assume a maximum fall of say three inches per hour, and compute our required culvert capacity by simple proportion. No elaborate instruments would be required, and the observations could be made by section foremen on constructed line, and by members of the engineer corps on new construction. I think in this way we would eliminate much of the uncertainty which follows from the use of the various formulæ.

The first plan called for a pavement or flagging of large, flat stones 1 ft. thick, on which the side walls were started 3 ft. high, 3 ft. 3 ins. thick at base, and battered 2 ins per ft. at back, from which a semicircular arch of 3 ft. rise and 6 ft. span was sprung, with an arch ring of 18 ins. depth and backing carried up 2 ft. above the spring line. Cut-stone work with dressed joints and beds was specified throughout, ranged work outside, and broken courses within. The wing walls were regularly stepped down in courses 1 ft. thick and were rounded into the side walls. This latter feature was accomplished by causing the face of the wing walls (battered 1½ ins. per ft.) to intersect the side walls at the spring line of the arch. This would naturally cause the battered face of the wing to project in front of the culvert opening; but by cutting away this projecting portion, so as to round the ring walls into the side walls, the junction between wings and sides was effected without leaving any angle to catch floating timber and other obstructions. Moreover, such a rounded or funnel-shaped entrance for the water adds materially to the capacity of the culvert when running under a head.

I think this method of construction has only to be understood to be widely adopted; 18 ins. is a rather unusual depth for an arch ring of 6-ft. span, but was adopted because of the height of bank (67 ft. from bed of brook), the somewhat low crushing values found for the stone, and because the extra depth added but little to cost compared with the extra strength thereby obtained.

From some excavations made in 1886, I inferred we should have a stratum of tough blue clay of unknown thickness on which to start our foundation course. I suggested a series of test borings along the selected site, but there were no tools at hand for the work, and the company thought it an unnecessary expense.

We had an undisturbed stratum of earth, with a surface 6 or 7 ft. above the bed of the brook, giving supporting side walls of compacted earth for about 130 ft. along the lower end of the arch, the plan being to begin at lower end with a drainage ditch leading south into the brook below, and so advance north with the work, thus avoiding trouble with water by draining through the completed culvert.

The location called for about 1 ft. of excavation in the blue clay; but while excavating for the wings of the south portal, and when only 8 ins. of clay had been removed, we came upon a bed of bad quicksand between 4 and 5 ft. deep, apparently extending northward under the entire work. This led to a radical change in plan. An invert was substituted for the flagging or paving, and the entire structure was raised 1 ft. in order to interpose the undisturbed layer of blue clay between the quicksand and bottom of invert. Where this clay had been removed and the quicksand partly exposed, we filled in carefully with spalls, on which foundation we spread about 1 ft. of concrete, and upon this laid our invert and foundation courses.

The invert was carried in from the south portal with carefully cut stone work for about 40 ft., but a series of test borings proved that, going north along center line of culvert, the clay increased and the quicksand decreased in thickness. I therefore for the remainder of the distance laid the invert in rubble, well grouted with Alsen Portland cement mortar, using 4 of sand to 1 of cement, until the grout came to within about 4 ins. of the upper surface of invert, and then finishing with a grout of 2 sand to 1 of cement where exposed to running water.

An invert as a bottom for a culvert has this advantage among others, of concentrating the flow at low stages of water and so tending to keep the water-way free from obstruction. Our improvised augur for making test holes was simple but effective. It was merely one of the long 8-ft. augurs, 2 ins. diameter, with the iron stem bent into the form of a brace, which had been used up and discarded by our gang of bridge carpenters, and with it we easily penetrated 5 or 6 ft.

I will not describe the modified arch in detail, as the plans speak for themselves. It is in the main the original plan modified by the invert, and so has a little more area of water-way than at first intended. It is located on a pretty steep grade, 1¼ ft. per 100 (the average grade of brook).

To build cheaply, material must be handled cheaply. We had accumulated from bridge repairs a number of 20-ft. sticks of timber, size 6 x 15; with these we built at east end of trestle and level with the track a platform, and from it a chute running down the bank on which to unload and slide the stone. Six timbers laid flatways side by side, with two timbers edgeways for sides, gave us a chute 7 ft. 6 ins. wide supported on cross ties of same material spaced 10 ft. between centers, each timber drift-bolted to each tie and bolted laterally through all with inch bolts 8 ft. 6 ins. long. Five lengths of 20 ft. each gave us a total length of 100 ft. and fall of 60 ft., being at an angle of about 37° or slope of 1¼ to 1. This chute carried over 600 tons of stone, all that was used on the work, mostly in blocks weighing from 1 to 3 tons, without needing repairs and with no very great wear. Stones were unloaded from the local freight trains at the top of the chute, handled there by two men with bars and gas-pipe rollers, and allowed to slide down by their own weight, and received at lower end in a bank of sand and old railroad ties, in order to break the force of fall. There they were swung by a small derrick clear of the following stone and over on to a push-car, and were at once run off by hand on a temporary track to the work, where they were placed for cutting, and subsequently swung into place on the wall by another derrick. The derricks we had on hand. The cost of labor for setting them up, and building chute and a shed for use of cutters in rainy weather, was only $14.63; tracklaying, $7.70. Roofing of shed was of fence material afterward used in fence construction. Track material subsequently went into side-track construction, and the other material used was condemned bridge stuff. This expenditure of $22.03 paid for itself many times before the completion of the work, and did much to keep down the total cost.

At intervals of 40 ft. or so, 4-in. square stakes were driven on center line of culvert with top to grade of upper surface of key of invert. Centers were fixed by driving nails, and a mason's line was stretched from nail to nail. The key of invert was then laid in line and grade by this line; and as the work advanced a 6-ft. tram or template placed on the invert, with central notch over the center line, and properly leveled gave at once the outline of invert and location of side walls. The tram was used, however, in the cut work only, but line and grade was given throughout as above stated. The construction of the arch centers calls for no comment further than that they were supported from the floor of water-way instead of from a projection of the spring line as is usually the case.

Our trench, 15 ft. wide, was carried through a clear space of 24 ft. between trestle bents at a depth of 6 ft. below surface, trains running at a height of 66 ft. overhead. We here used for sheet piling (to keep earth from caving under sills of trestle) plank 1¼ x 6 ins., driven 18 ft. at bottom into a tough clay, and braced at top by old bridge timbers, dimensions 7 x 13 ins., placed at the plumb and batter posts of the trestle. When the excavation progressed north so as to cut through into the channel of the brook near its westward deflection, we built a temporary dam, turning the water still farther westward and completely out of our way, tearing away the dam on completion of the work. Old bridge timber and the natural soil were our materials for dam construction.

Excavation for masonry was begun June 15, 1887, and the culvert was finished in October. Filling by steam shovel and unloading plow began Oct. 10, 1887. The culvert proper contained 613 cu. yds. of masonry and 24¾ yds. of concrete. Masonry cost $4.09 per yd. for labor and $2.50 for material or a total of $6.57 per yd. Concrete (for labor only) cost $1.78 per yd. Stone quarrying was by contract, all other work by day's wages. I append an itemized statement of cost.

The work was carefully pointed inside and out with cement mortar, and the extrados of arch likewise received a good coating. We intended to use Black Diamond Brand Louisville cement, but a car-load lot obtained from a local dealer proved defective and led to the adoption of Alsen Portland cement throughout. With Portland cement we used four of sand to one of cement for interior work, and two of sand and one of cement where exposed to weather or water. Louisville cement we used two to one throughout. In special places we used as high as one to one of Portland. The arch ring was set entirely in Portland mixed usually two of sand to one cement.

For cement testing, our people objected to paying from $75 to $150 for a testing machine, and we built one at our shops at an expense of $15 that answered well enough, its essential elements being an ordinary spring balance with rotary index hand, weighing by ounces up to 30 lbs. or 480 ounces, and a lever connection by which each ounce on scale represented one pound stress on the briquette of cement. All unregistered weight was taken off by the briquette by a counter-weight and cord carried over a pulley, and the briquettes were ruptured by a lever and the pressure registered by a tell-tale index hand. I am convinced that the slight errors of such a machine are far within the ordinary variations caused by differences in the ramming of the cement and that it is as good for all practical purposes as any of the high-priced machines.

I feel I ought not to close without saying something about steam shovel work. With good management a shovel will accomplish much at a minimum cost, while with poor management the little that is done will be at a cost so unreasonably large as to create a prejudice against the shovel often difficult to overcome. From what I have seen of shovel work I should invariably have the shovel, plow, engine and flat cars over hauled and put in thorough repair before beginning a job of work. Delays will be many even when this is done, and each delay means an expensive plant and a gang of men idle at heavy expense. It is important, also, to strike a proper balance between the work of the shovel crew and train crew respectively, so that neither will have to lose time while waiting for the other. As a rule, the length of haul is a fixed quantity, and the maximum economy will occur when the shovel has trains always ready when it is ready to work, and the trains find the shovels always ready to load on their arrival. In practice we should approximate as closely to this state of affairs as possible. We should aim to move the shovel while the trains are unloading, and to accomplish this it will sometimes be advisable, within moderate limits, to fix the number of cars loaded per train by the height of bank in which shovel is working. With a short haul and a low bank, we may put in as many flats as the shovel can load in one shift, say 15 to 25, depending on hauling capacity of engine over the given grades, etc., and then occupy the time the train is away in shifting for next load. With a longer haul and higher bank, a few extra flats could be left for the shovel to work on after shifting and before arrival of train; and with a still longer haul and lighter bank, two trains could be used, one loading at the shovel while the other unloads at the work.

It is well to have a competent and energetic man on the ground in charge, paying him a generous compensation, and looking to him to get the maximum of work possible out of the plant and crews. Our foreman is an old freight conductor, who acts as engineer at the shovel and conductor on the train, and is in command of both train and shovel crews, receiving $125 per month. He is emphatically the right man in the right place, and a valuable man for the company. Even with the best of crews and foreman, a close daily supervision is indispensable in order to keep the plant up to its full duty.

Our shovel is of the Otis type, built by John Souther & Co.; cuts about 24 ft. wide to a depth of 4 ft. below the track. We have been working in a bank about 12 ft. high and loading 12 flats for a train load. Shifting shovel occupies about five minutes. Our haul averages about 4,000 ft. Under ordinary circumstances, it takes about 15 minutes to handle the cable and plow off, but by an ingenious contrivance for loading the cable, devised by Mr. B. FAGAN, foreman of bridge repairs, we have reduced the total time of unloading to about 5 or 6 minutes.

Our usual complement of men consists of a foreman in charge of the work, who acts as train conductor and engineer of shovel, at $125 per month; a cranesman at $2.00 to $2.50 per day; a foreman for shovel at $1.50 per day; four pitmen who clean after the shovel, assist in moving it, and in clearing the tracks and handling the cable in plowing off, each at $1.25 per day; and one watchman at $1.00 per day.

We have thus far handled 2,612 car-loads or about 21,000 cu. yds. of earth filling, at a cost for labor, repairs and supplies of 59¾ cts. per car, or 7¾ cts. per cu. yd. Fuller details are given in the table below, which table is a record of about 22,000 car-loads of earth handled by our shovel during the last three years. We have loaded as many as 124 cars per day, and have averaged 68 per day summer and winter. Our average expense for loading merely, which includes wages of shovel crew, repairs to plant, and about one third of the supplies, is about 40 cts. per car, load or about 5 cts per cu. yd. Total expense for loading, transporting about

COST OF ARCH CULVERT.—613 CUBIC YARDS OF MASONRY.

Items.	Total cost.		Cost per cu. yd.
Cutters and helpers, cutting stone	$1,370.48		$2.24
Templates, straight edges, bevels, etc.	11.00		.01
Repairs of cutters' tools	52.39		.09
Water boy	11.75		.02
Total cutting	$1,445.62	$1,445.62	$2.36
Masons, laying stone	$ 384.87		$ .63
Helpers to masons	453.06		.74
Mortar mixer	121.72		.20
Water boy	11.75		.02
Track laying	7.70		.01
Derrick, stone chute, etc	14.65		.02
Arch centers, built and erected	37.65		.06
Total laying	$1,031.98	$1,031.98	$ 1.68
Pointing		$ 30.00	$ .05
Total labor		$2,507.60	$4.09
613 yds. stone @ $1.50		$ 919.50	$ 1.50
100 bbls. Alsen Portland cement (German)	$ 315.00		
30 " " "	97.50		
40 " Burham " " (English)	130.00		
20 " Louisville " (Anchor Brand)	20.00		
10 " " (Bl'k Diamond)	8.75		
Total cement	$ 571.25	$ 571.25	$ .94
7 car-loads sand @ $5.50		38.50	.06
Total material		$1,529.25	$2.50
Grand total		4,036.85	6.59
Concrete	$ 43.75		
Excavations for foundations and drainage	260.77		
Sheet piling	19.69		
Timber for drain trough	2.59		
Extra allowance on sheeting stone	20.00		
Total	$ 346.80	$ 346.80	
Grand total		$4,383.65	

MISCELLANEOUS DATA.

CEMENT.—125 lbs. per yd. of masonry, or 2 2-5 yds. masonry per bbl. of Louisville of 300 lbs., and 3 1-5 yds. per bbl. of Portland of 400 lbs.

SCALE OF WAGES.—Foreman, $3.50 per day of 10 hours; cutters, $3; carpenters, $2.50; mortar mixer, $1.50; laborers, $1.25; water boy, 50 cents.

Cars loaded with about 12 yds. of stone.

Steam Shovel Work, Indianapolis, Decatur & Springfield Ry. Under Supervision of A. J. Diddle Roadmaster.

Data.	Sangamon River Trestle.	Montezuma Gravel Pit.	Sangamon River Trestle	"Guion" Trestle	Nichol's Hollow Trestle.
	1885	1886	1886	1887	1887
First car loaded	Oct. 26	Jan. 19	Sept. 3	May 28	Oct. 10
Last car unloaded	Dec. 18	July 24	Oct. 21	Sept. 12	Nov. 30
Total number of days	54	186	48	108	51
Number of working days	46	115	38	85	40
Days idle in addition to Sundays	0	45	3	7	4
Nature of material handled	light clay	gravel	light clay	light clay	light clay
Average height of bank	10 ft.	12 ft.	10 ft.	10 ft.	12 ft.
Total number of cars loaded	2,899	8,631	2,771	5,254	2,523
Greatest number of cars loaded per day	94	124	90	80	75
Least number of cars loaded per day	22	16	20	30	15
Average number of cars loaded per day	63	75	73	61.8	63.2
Average length of haul	1 mile	9 miles	1 mile	2 miles	¾ mile
Grade—Shovel to Dump—feet per 100	—1.00	varying	—1.00	—1.00	—1.00
Tons of coal used—shovel and engines	141	853	99	170	65
Number of car loads per ton of coal	20.5	10	28	30.9	38.9

Cost of Work per Car Load.

	Cents.	Cents.	Cents.	Cents.	Cents.
Foreman at $125 per month	8.86	9.67	8.00	9.01	9.88
Cranesman at $2 to $2.50 per day	5.35	5.62	4.80	3.54	5.57
Fireman (shovel) at $1.50 per day	2.88	3.37	2.87	2.90	3.27
Laborers (4) at $1.25 per day	7.86	9.92	8.77	9.80	9.80
Watchman at $1 per day	2.07	1.96	1.88	2.50	2.25
Total shovel crew	27.02	30.54	26.32	27.75	30.77
Engineer and fireman (engine)	12.00	14.50	7.44	11.00	13.10
Trainmen (conductor, $2.50; brakemen, $1.50)	5.97	14.60	5.74	5.25	5.77
Total train crew	17.97	29.10	13.18	16.25	18.87
Helpers distributing earth at $1.10		1.12			2.72
Helpers loosening frozen ground ahead of shovel, $1.10		0.62			
Section men (track work) at $1.10	0.81	1.88	1.38	1.45	2.08
Bridge carpenters (repairs to plant) $2.50	0 15	1.58	0.16	1.04	
Section men (repairs to plant) $1.10		0.62			
Shop bills (repairs to plant)	1.69	10.90	1.27	10.60	1.67
Total repairs to plant	1.84	13.10	1.43	11.64	1.67
Coal at from $1.25 to $1.41 per ton	6.31	13.30	4.47	4.31	3.28
Oil, waste, etc	0.52	1.55	0.75	0.86	0.36
Total supplies	6.83	14.85	5.22	5.17	3.64
Grand total per car load	54 47	91.19	47.53	62.26	59.75
Cost per yard at 8 yds. per car	6.43	11.40	5.94	7.79	7.47
Add per yard for interest on cost of plant	1.00	1.00	1.00	1.00	1.00
Cost per yard including interest	7.43	12.40	6.94	8.79	8.47

1 mile, unloading with plow, and distributing on bank when necessary, is about 37 cts. per car-load or 3 cts. per yd., which includes all possible expense except interest on cost of plant. On our third job, under favorable conditions, we have a record of 47¼ cts. per car-load or about 6 cts. per yd., which was trestle filling at the Sangamon River near Decatur. Other data will be found in the table.

The report of the Roadmasters' Association for 1885 contains some steam shovel data which it may be of interest to compare with the above figures:

1. The Baltimore & Ohio road, loading with steam shovel and unloading with side dump cars, claims to haul 8 to 25 miles, including train service and supplies, at 8-1 cts. per yd.

2. The Michigan Central road presents a record of 20,000 car loads of gravel, banks 7 high, at a cost for loading of 4½ cts. per yd, including coal, oil, waste, labor and repairs. Cost per yard for hauling 30 miles, 735 yds. per day, two trains and crews, 4 cts. per yd. for labor only.

3. The Ohio Central road, with steam shovel and ballast unloader and train of 30 to 35 cars, claims an average cost for hauls of various lengths of $1.00 per car, or say 12 cts. per yd.

4. The N. Y., P. & O. Ry. gives 7 cts. per yd. at the rate of 8 yds. per car, as cost of loading by steam shovel.

5. The Central Iowa road presented, as their record of 4,800 car-loads handled, the following figures:

Loading	38 cts. per car, or 4.75 cts. per yd.	
Unloading	15 " " " 1.9 " "	
Engine service	25 " " " 3.1 " "	
Total cost	78 cts. per car, or 9.75 cts. per yd.	

Our figures, it will be seen, do not suffer by comparison. Much of the credit for them belongs to our roadmaster, Mr. A. J. DIDDLE, who has charge of our steam shovel work, and to whom I am indebted for much advice and counsel in connection with the culvert work herein described.

Irrigation in Wyoming.

We abstract the following from an article by Mr. C. A. MILLER, C. E., which recently appeared in the Rawlins (Wyo.) *Journal*:—

Regarding irrigation laws, the writer says that Wyoming has followed, with improvements, those of Colorado. The Colorado laws are considered an improvement upon the earlier ones adopted by California, for in the latter State the generally accepted riparian rights of owners of lands bordering on streams to a certain amount of water from that stream were first in vogue, and this practice caused much trouble between mining and agricultural interests. Colorado undertook to avoid these difficulties, and based her fundamental law on the doctrine of "prior appropriation," under which those first making use of the waters of a stream have the right thereto. The working of this law has been so satisfactory that California has recently adopted the same principle, and the Kansas Legislature has lately memorialized Congress, asking for a national law based on the principle of "prior appropriation" to govern in all interstate questions. In a convention of California irrigators, the Colorado unit of measure was also recently adopted, it being one cubic foot per second.

Next to good laws Mr. MILLER says that forestry and rainfall have perhaps attracted the most attention. He insists upon the necessity of preserving the timber at the headwaters of streams. In speaking of the late and extensive discussion of the increase of rainfall on the plains, Mr. MILLER says that whatever the tendency may be, the people of Wyoming will find irrigation a necessity if agriculture is to succeed. He does not think there are more than 6 rain gauges in the Territory, if that, but believes that the rainfall is about the same as the average for Utah, Idaho, Colorado, and Kansas.

Wyoming is well supplied with streams suitable for irrigating purposes. In point of capacity the more important streams are: the Big Horn, North Platte, the Green and Powder rivers, the Snake river of the South, the Medicine Bow, Sweetwater, Cheyenne, and the Belle Fourche. No large section is without water for irrigation, unless it is the Red Desert. Most of the streams have narrow bottoms, but that of the Big Horn is wide and affords some of the finest land in the Territory.

Perhaps Johnson Co. (in the north central part of the Territory) has carried irrigating and farming farther than any other county.

It is estimated that seven-eighths of the flour consumed in Wyoming comes from outside the Territory, as do many of the potatoes and much of the butter. There is plenty of land needing only irrigation to make it arable. The uplands are especially, and often only, suitable for stock-raising, but farming can be carried on in the lowlands.

Mr. MILLER calls especial attention to the resources of Carbon Co., mentioning among her streams the North Platte, the Medicine Bow, the Snake river of the South, the Sweetwater and Powder rivers, and Savey creek. He estimates that there is sufficient water in the county to irrigate four-fifths of its area, and mentions that there are especially fine reservoir sites near Rawlins.

GRAN GUIVERA, ruins of an ancient city known to the Spanish explorers, has been again discovered by engineers of the El Paso & Mexican Railway. They found the ruins of gigantic stone buildings, built in a substantial manner, and one of them covered an area of four acres. There was every indication of a one-time dense population, although the nearest water is now 40 miles away. Immediately to the south lies the great Moipais lava bed, 40 miles long by from 1 to 10 miles wide, and on all sides the country is covered by fine, white ashes of unknown depth.

ENGINEERING NEWS
AND
AMERICAN RAILWAY JOURNAL.

Published Weekly at Tribune Building, New York.

VOL. XXI. Saturday, June 8, 1889.

D. McN. STAUFFER A. M. WELLINGTON
EDITORS.
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Drawings for publication *should preferably be in plain black and white, considerably larger than they are expected to appear, with letters and figures in pencil only, all lines clean and bold.*

Coming Technical Meetings.

Civil Engineers' Club of Cleveland, O.—Regular meeting June 11. Secy., James Ritchie, Case Library Rooms.

New England Railway Club, Boston, Mass — Regular meeting, June 12. Boston & Albany passenger station.

New England Water-Works Association.—Annual meeting at Fall River, Mass., June 12, 13, 14. Secy., R. C. P. Coggeshall, New Bedford, Mass.

Engineers' Club, Philadelphia, Pa.—Regular meeting June 15. Secy., Howard Murphy, 1122 Girard St.

Engineers' Society of Western Pennsylvania, Pittsburg, Pa.—Regular meeting, June 18. Secy., S. M. Wickersham, Penn Bldg.

American Railway Master Mechanics' Association.—The annual meeting will be held at Niagara Falls, N. Y., beginning June 18. Secy., Angus Sinclair, 140 Nassau St., New York.

American Institute of Mining Engineers.—Next meeting at Denver, Col., beginning June 18. Secy., R. W. Raymond, 13 Burling Slip, New York City.

Boston Society of Civil Engineers. — Regular meeting, June 19. Secy., S. E. Tinkham, City Hall.

New York Railway Club.—Next meeting, June 20. Rooms, 113 Liberty St., New York City.

American Society of Civil Engineers, New York.—Annual convention at Seabright, N. J., June 20. Secy., John Bogart, 127 E. 23d St.

Master Car-Builders' Association.—The annual meeting will be held at Saratoga Springs, N. Y., beginning June 25. Secy., J. W. Cloud, Buffalo, N. Y.

THE awful disaster at Johnstown, which will make this week forever notable in the records of great calamities, will not be wholly unfruitful of good if it shall lead, as very possibly it will, to more thorough public supervision of such sources of danger; for it is to the general apathy of the public rather than to the exceptional carelessness of individuals that *the blame for* this dread disaster may be most justly attributed. That there was negligence on the part of the South Fork Fishing Club in selecting an engineer seems but too probable. The engineer whose name is mentioned in that connection—and who, happily for him, is now dead—was at least never a member of the American Society of Civil Engineers, nor, so far as we can ascertain, of the local engineering society; nor is he known to us, or to various well-informed engineers whom we have consulted, by reputation. Therefore, while he may nevertheless have had a long and creditable professional career, he can hardly have been an engineer of such prominence that he might properly have been trusted with such an exceedingly responsible and delicate professional duty as complete control over the reconstruction of a dilapidated dam of large size and in a highly dangerous situation. That he was unduly limited in the allowed expenditure, or felt himself to be, seems also most probable from the small sum expended in reconstruction, $17,000. What was to be expected from a mere fishing and hunting club, whose members knew from experience little or nothing about construction, who had no serious end in view to justify large expense, and who, even at that price, were paying pretty dear for their fish? No doubt had they had some $5,000,000 iron works of their own below the dam to be endangered by it, they would have been more careful than they were to ensure the excellence of their engineering construction; it would then have been more truly their business to do so. But to attempt, therefore, to throw the whole blame for this disaster, or any considerable part of it, on these individuals, seems to us rather an unwarranted *ex post facto* outburst of public virtue, having in it an element of meanness akin to that which occasionally breaks out when the whole blame for some railway disaster is thrown upon an ill-paid employé who has "broken the rules," in hopes that the public will forget the far greater error of those above him, who have provided no better safeguard than rules depending on human memory and caution, which experience makes it absolutely certain will occasionally fail when most needed.

The public, and not any individuals, should in justice carry the heaviest share of blame for this dread disaster, in that it takes no trouble to ensure effective expert supervision of such sources of danger, but either does nothing at all, or creates offices, and guards the filling of them so carelessly that they become mere political spoil, and are filled by political and not technical experts. What more can we rationally ask of any man than that he shall take as much care for our safety as we take for our own? And who was most concerned to have that dam safe, the men who built it to make a fishing pond, or the public below it whose lives depended on its staunchness? The answer is too plain for words. Unless, therefore, it can be shown that these unhappy fishermen *knew* they were taking chances and endangering life or had reason to suspect it of their own knowledge, which there is not the slightest reason to believe or to charge, the blame which rests upon them is only their proportion of that which rests upon the whole public for inexcusable and inveterate carelessness about the hands to which are entrusted works affecting the public safety, and the means taken to secure it. The purpose sought by the club in rebuilding the dam was a lawful and proper one,—to provide a pleasure ground for themselves and their families. They wanted an engineer to build it, and they got one whom the great public tacitly declared was a good enough engineer for them: for they had a right to assume that any man announced by his sign as such, and who was permitted *by the public* to build any kind of structure without supervision or check upon his work, was competent to perform that work. He at least knew more than they did: and who has a right to blame them that they trusted to him implicitly their paltry dollars, when the public likewise proceeded to trust him implicitly with the lives of thousands of helpless human beings?

We confess that this responsibility of our whole body politic for the disaster seems to us the most obvious moral of the occurrence. We cannot but feel that indignation may be most profitably and most justly directed, not at the unhappy men whose rightful search for pleasure has ended so sadly, but to those reckless political methods and conditions which disgrace us as a people, in that they do not leave room for even one man in each State to hold office as an expert and not as a politician, with the pay and the permanency of tenure by which alone true expert services can be secured.

As is but natural, the catastrophe of last week has set every town that has a dam near it, or proposes to build one, to speculating on the possible effects of a rupture of this dam. Of course, the proposed Quaker Bridge dam above this city is receiving the full share of attention which its great dimensions and the volume of water to be impounded demand, and the possibilities pictured in the imaginings of newspaper scribes are simply appalling. It is true that the dam is to be the highest in the world, and the lake behind would be of great extent and with a surface high above tide level; but the remaining conditions would be very unlike those in the narrow, rocky, but thickly settled valley of the Conemaugh which brought about the late terrible calamity there. Instead of an earthen dam, doubtless well built for its day and type originally, but abandoned for years, and then cheaply tinkered up for a second tour of duty, we would have a dam of solid masonry, designed in the light of the latest engineering science and experience and built without stint of money or care. Nothing short of an earthquake could move such a dam as is here proposed, and flood water in any volume is provided for and could not harm it. But if the dam did break, what then? The distance from the site of the dam to the Hudson along the Croton valley is less than a mile, and we believe there are no houses in this rocky ravine. Consequently, until the river is reached, no human life could be lost. But the river here is really the Tappan Zee, a virtual lake, so broad in surface that even the sudden addition of the waters of the new Croton lake would have little more effect upon it than to create a considerable swell and perhaps wash the wharves of the nearest villages and towns. As to its effect upon New York, any stiff breeze that backs up the tides and floods the cellars on West street would do immeasurably more damage. There is no danger, therefore, from the building of the Quaker Bridge dam, however much there might be in permitting ignorant fear to obstruct its speedy completion. The only serious danger and calamity to the citizens of New York lies in the possibility of its not being built.

The staff engineer of our worthy contemporary, the New York *Times*, was evidently absent from his post when the editorial of last Tuesday on "The Sufferers and the Responsibility," was written. Speaking of the catastrophe in the valley of the Conemaugh, the *Times* says:

> Judging from its dimensions, it must have been a masonry dam, and from the data now at hand we may say with positiveness that it was a dam which should never have been built. No "waterspout," no "cloudburst," no cyclone, earthquake, or other overmastering convulsion of nature released the waters contained by the dam. A heavy and unusual rainfall upon the region tributary to the lake filled its bed until the water rose above the top of the dam and overflowed. Masonry dams are not built or intended to withstand such a test. Whenever the waters they contain rise to the point of overflow, they are doomed. The dam maintained above Johnstown by the fishermen of Pittsburg furnished no exception to this well-known rule. At 2 o'clock on Friday afternoon the water of the lake broke over the crest of the dam, at 3 o'clock the dam gave way, and at 4 o'clock the lake was empty.

To engineers, the above extract needs no comment. Our contemporary has simply reversed the safety conditions of masonry and

THE EIFFEL TOWER.

(From a photograph)

CHAS. HART & SONS. LITH. 36 VESEY ST. N. Y.

earthen dams when overtopped by floods. Water passing over the crest of a dam of earth is fatal to it, while masonry dams are often constructed to permit such passage without danger, and over a spillway extending along the entire crest of the dam. Our own Croton dam is an example of a liberal spillway over the dam, and the new Vyrnwy dam for the Liverpool water-works is an example of the extreme extension of this spillway over the length of the dam. Every wooden mill-dam in the country takes the water over it at all times, and earth is the material least adapted to this disposition of flood water.

We give up an unusual proportion of our space this week, in which perhaps the thoughts of our readers will be chiefly fixed upon other matters, to a discussion of the good and bad points of iron highway bridges and viaducts by Prof. WADDELL, in hopes that its practical hints may tend to lead to a much needed improvement in average practice in regard to such structures. While to many of our readers the suggestions of the paper may be needlessly elementary, to others, who do not make a specialty of bridge construction, yet have more or less control over such structures, the paper may furnish just what they need. Not all the statements of the paper will pass without challenge probably, and, after all, the chief sinners in regard to such structures are not engineers, but public officials above them, who are not likely to be effectively reached by ENGINEERING NEWS. Nevertheless, there is but little in the paper that any engineer will be disposed to question, and we hope and believe that its publication may do good.

THE paper on rail sections, by Mr. FREDERICK A. DELANO, Chief of the "Bureau of Rail and Rail-Joint Inspection Tests and Records," of the Chicago, Burlington & Quincy Railroad, which is reprinted in another column, we especially commend to our readers as preaching, from first to last, sound doctrine which has been too much neglected. His suggestions correspond precisely, in their substance, with the conclusions which all engineers who have been studying the subject with care have been reaching lately; but few have devoted so much study to all the details of the question as he; and it is much to be regretted that the awful catastrophe of this week has come at a time to distract, as we fear it may, much of the attention which the paper would otherwise have. The proposed form of specifications contains some especially good points as to speed of rolls, heat of finished rails, drop tests, treatment of ingots, etc., which are not ordinarily so carefully provided for, in accordance with reasonable necessities, before we shall have rails what they ought to be. A large part of the trouble with rails, we are confident, has arisen from these three causes, which have no direct connection with the quality of the metal, viz.: 1. Bad form of sections; 2. Too hot rolling, necessitated largely by the bad form of sections, in that the webs and bases were very thin; 3. Too fast rolling, encouraged largely by the great heat necessary, and tending to still further increase the heat used. The proper conditions as to the form of the section are naturally not touched upon in the specification, since it is settled in advance, but it is very ably discussed in the body of the paper; and if, as now seems likely, we are soon to have standard rail sections, as noted last week, it is a practical certainty that they will be developed on precisely the lines outlined in this paper, although, perhaps, not precisely agreeing with its specific recommendations.

WE rejoice to learn from the paper describing the Pennsylvania Railroad experiments in electric car lighting, which is reprinted in another column, that these experiments are deemed to have resulted very satisfactorily; so much so, in fact, that the results are stated in the following gratifying terms:

So far as the Pennsylvania Railroad is concerned, the electric lighting of passenger trains may be considered an assured success; and leading, as it does, to the abolition of kerosene lamps, and incidentally encouraging the adoption of steam heating, the safety and comfort of the passenger is certainly increased.

The inconsistency between these statements and the reported intention of the Pennsylvania Railroad to introduce extensively a gasoline or "carburetter" system of lighting, on which we have felt it a duty to comment adversely in recent issues, we cannot attempt to reconcile; but from the past history of the Pennsylvania Railroad, which has thrown its influence steadily in favor of the best and safest appliances, and has been quick to rectify mistakes tending in the other direction when this tendency was discovered, we are satisfied that the paragraph outlines what will be the ultimate policy of the road, if not as respects electric lighting, then as respects some other equally safe system. What would be gained, if, having "abolished kerosene lamps," gasoline lamps of any kind were put in their place, or what would be the use of "encouraging the adoption of steam heating," if the Baker heater in each car was to be replaced by what might easily become an even quicker and more certain method of spreading fire—six 2-gallon tanks of gasoline attached to each car—it would puzzle any one to determine.

A little crossing disaster which occurred last week on the Long Island Railroad, happily without loss of life, is worthy of more than passing note. The circumstances, as described in the daily press, were these:

The engineer and conductor were guiding some empty cars down the incline from Fulton Ave., along Vesta Ave., Brooklyn, at 3 P. M. yesterday, when the brakes gave way, and the train ran swiftly to and across the Long Island Railroad tracks in Atlantic Ave. When the cars were half way over, a west-bound train of five cars, filled with Grand Army men and women and children, came around a curve, and the engine struck the middle one of the empty cars. The shock was very great, but only one person in the crowd of people was injured, and he was only slightly hurt. The engine which drew the passenger train was badly damaged, and travel on the road was delayed for an hour while the wreck was removed. The engineer and conductor having the empty cars in charge were arrested but not held.

The largest excursion passenger traffic in the world, or nearly the largest, is handled, during the months which are now opening, on the Long Island Railroad. It is handled in the main well and safely, and it would be improper not to recognize that fact. Moreover, the Long Island has been by no means the most laggard road in introducing interlocking safety appliances. It has done a great deal already in that direction, and, although its persistent use of the noisy Smith vacuum brake, which has been abandoned on nearly all other roads once using it, does not seem to be particularly progressive, yet the brake stops the trains, and does well enough, possibly, to relieve the road from serious reproach on this account. Yet how exceedingly crude and careless is the whole system of handling a heavy passenger traffic revealed by the above brief record! The tracks are at the street level, the cars are frail, and in summer chiefly open, so that a slight collision may do fearful damage; the crossings, in this case at least, are without any effective protection, the only truly effective one being interlocking apparatus and derailing switches. Add to this that excursion and suburban trains run across streets at grade, in many parts of Brooklyn, at high speed and with only the protection of a flagman, and we have a picture of bad practice which ought not to be tolerated an hour, and for which there is no longer any shadow of excuse, except that it is a survival from the days of small things, but which seems likely, because of public apathy, to endure for a good while to come.

THE particular attention of manufacturers is called to the next meeting of the New England Water-Works Association, commencing June 12. Professionally, the meeting promises to be a most interesting one, and the exhibit of all manner of water-works' appliances, capable of such exhibition, will enable manufacturers to make the event commercially profitable to them. The success attending similar exhibitions at Cleveland last year and at Louisville this year should tend to bring out an excellent display at Lowell. Applications for space should be made to Mr. R. C. P. COGGESHALL, New Bedford, Mass.

The Johnstown Disaster.

The disaster which has horrified the world this week is, so far as we can discover, by far the worst one in the history of mankind which is directly chargeable to defects in man's devices, and to nothing else. Its terrible fatality outdoes all but the greatest battle records, and it is to the records of earthquakes only, and to one or two floods in China, like that of the Yellow River in 1887, in which 100,000 are said to have perished, that we must turn for any death records surpassing it. Thus at the battle of Gettysburg, which was easily the most important of our battles, and almost if not quite the most fatal, the casualties only aggregated as follows:

	Killed.	*Wounded.*
Union	2,834	13,713
Confederate	5,000	23,000
Total	7,834	36,713

We are not advised how many of the wounded afterwards died, but it is only too probable that the deaths within twenty minutes at Johnstown, and in the beautiful valley above it, outnumbered all those who died, either at once or later, as an effect of the two day's Gettysburg fight, while it is quite certain that the aggregate will exceed the 7,834 above reported as killed. The true total will never be known, but it seems to us now more than likely to have been nearly twice that total.

So awful a disaster makes us indisposed to discuss any of its technical features more fully than we have done elsewhere, until all the facts are known. The best method to ascertain them seemed to be by direct investigation on the ground, before too many of the evidences which will tend to reveal causes and the course of events have been effaced by man or the elements. That method of ascertaining the facts we have chosen, and we shall hope next week to lay before our readers as much as can be determined, after the event, about the facts in the case. In the meantime, however, it is impossible to be wholly silent, although one must deal to some extent in generalities, until fuller knowledge is available.

Fortunately, there are enough such generalities which ought to be said to occupy all and more than all of the time and space at our disposal. One such we have just commented upon above, that the real responsibility for this disaster rests most heavily upon the public, for its careless guard of its own interests and safety, and not upon the individuals who were the unfortunate immediate

instruments of the disaster, and who cannot be expected to take more care for the public than the public takes for itself, until human nature has been regenerated. But there is another moral of this event which ought to impress itself especially on engineers, and we hope and believe it will do so.

If anything can be said to be clear about it, it is that the dam—poor structure as we must now believe that it was—failed just when and as it did merely for lack of *a little* more sectional area in the spill-way. For nearly half a century this spill-way has sufficed; it may have been at times severely tried, but it has never before caused water to actually run over the top of the dam, and it probably would not have done so on this occasion had there been slightly more provision for normal discharge; because the area of the impounded water was not very large, not over 450 acres at most, to judge by the old reports, and the water took many hours to rise to the crest level. Now, we cannot always, by indefinite increase of expense, make it certain that no harm shall come to a structure, as we have often said and now repeat, although it seems a poor time to do so. To do this in respect to culverts and bridges, for example, would more than double the cost of all of them, and then we should not be sure; for if any road may be said to be beyond reproach in respect to such structures it is the Pennsylvania. No road in the world, or certainly none in this country, has spent more money on bridges and culverts to make them absolutely safe, and a week ago the whole road was the ideal of solidity. Yet it has suffered more in this storm, probably, than any road on the continent ever did in any one storm.

But what we can do, in designing all such structures, is to take pains to get every last fraction of stability that we can get for the money by more careful design, and not ridicule the gain because it may be small or even dubious, or because "the structure is made strong enough anyway." No structure is strong enough anyway. A very prominent and recent example of such a seeming tendency is in respect to the section and ground plan of the Quaker Bridge dam, which we have heretofore discussed, and as to the probable dangers from which a flood of nonsense will probably be poured forth from the daily press shortly; in fact, it has already begun, using this disaster as a text and warning.

But we prefer to speak first of smaller matters, as for instance the plain ends of arch culverts, such as the one we illustrate this week. There is a discreditably prevalent custom among engineers of building arch culverts with a square shoulder connecting the wing wall with the abutment wall. It may be called the standard plan. The other, and in our judgment the only defensible plan, is the rare exception. The shoulder has the effect (1) to furnish the best possible lodgment for floating obstructions, (2) to decrease somewhat the discharging capacity under head or at a given depth, (3) to increase somewhat the cost. But it is a little easier to design this way and—it is the old familiar plan. We never heard an engineer maintain that the plan was really better or *quite* so good, but we have heard them maintain that the difference "was not worth talking about"; "that they did not figure their culverts so fine" and "never designed them to run more than half full," etc., etc. Many a culvert, we surmise, has gone out in consequence, in this very storm.

Another such matter, as to which a like contempt of "hair-splitting" is manifested, is as to the design of rail sections; but to point out just why and how in this article would lead us too far. Still another is the question of car lighting by gasoline, which we have had occasion to discuss recently. No one in his senses questions that a gasoline apparatus for car lighting, or for house lighting, can be designed which shall be *generally* safe, which shall only become unsafe under (comparatively) rare and peculiar combinations of circumstances. The heating of cars or houses by the combustion of dynamite might possibly be made generally safe. But who shall say that the general use of gasoline for car-lighting might not start a second Chicago fire. And what is gained by taking even that ghost of a chance, with such an awful penalty if the chance materializes?

Another case where engineers take chances in an entirely unwarrantable manner is in the design of bridge floors, but here again we touch upon a subject which to properly discuss would take a separate article. We regard it as susceptible of demonstration that an even half of the bridge floors of the country may be made far more safe at the same cost, with an almost equal gain from a slight and really insignificant increase in cost. But we prefer to devote what space we have left to another phase of the Quaker Bridge question, which has already assumed prominence as a result of this week's disaster.

Desperate efforts will now be made, of course, and they have already begun, to prove that the engineering work on the Johnstown dam was all right. We do not say that it was not—as yet. But this fact once granted, an evidently plausible argument is presented thus: This dam was designed by an engineer of good standing; more cannot be ensured for any dam. This dam has failed; all dams are likely to fail. The *Evening Post* of June 3, for example, first quotes the Philadelphia *Press* as giving "important information" as to the quality of the engineering service on the Johnstown dam,—when all it gave was its own unsupported editorial affidavit that it had been first-class throughout,—and then carries the reader along the above outlined path of reasoning with many curiously absurd statements about the limits of engineering knowledge, and ends with the conclusion in italics, that "*no such construction is safe*," from which it is an inevitable step to the further conclusion that the Quaker Bridge dam should not be built under any circumstances.

Now, the *Evening Post* is an authority on matters political which we are not disposed to dispute; but had it proceeded to reason from the Buddenseik buildings that "no brick structure was ever safe," and ordered the gradual demolition of the Evening Post building before it should fall into the street—as its well-known public spirit would no doubt have led it to do—it could not have committed itself to a more egregious blunder regarding matters technical than it has done in these statements; for there is no more rational basis of comparison between the two cases. And we say this more readily and emphatically because we have never hesitated to express our convictions about the plans for that structure, which have by no means coincided, and do not yet altogether coincide, with those of the engineers who had had to do with the Quaker bridge dam.

Whatever may prove to have been the professional standing of the engineer who reconstructed the Johnstown dam, and however free from blame the South Fork Fishing Club may prove to be in consequence, for carelessness in selecting an engineer, it is already painfully evident that the engineering work was anything but demonstratively good, not from the fact of failure, but from many details which have already come to light and which do not occur in good practice, and need never happen if care be taken to ensure good practice. Why and to what extent this was so we can show better, because more completely, next week; but engineers cannot too early or too emphatically insist that it is so.

The Effects of the Storms of Last Week.

The great storm which occurred May 30 extended over a large section of the middle Atlantic States, and other heavy storms about the same time caused much damage throughout the country, from Canada in the north to Louisiana in the south and as far west as Missouri. The magnitude of the disaster in Pennsylvania has caused the general extent of these storms to be overlooked, but we give below a statement of the damage done, compiled from the dispatches in our exchanges.

Canada.—Heavy rains have fallen lately in the district around Coburg, Ont., and on June 1 a sudden heavy storm swelled the creeks and flooded the town and the country down to Lake Ontario. A number of bridges and mill dams were swept away and a breach made in the embankment of the Grand Trunk Ry.

Michigan.—The heavy rains of the storm of May 30 raised the water in the streams considerably, but no serious damage is reported. Snow fell in some parts of the State during the storm. Snow also fell at Tuscola, Ill.

Indiana.—The heaviest rainfall experienced for several years occurred May 30 and 31. Snow fell at Michigan City and Winamac.

Missouri.—A heavy rainstorm prevailed May 28 and 29 extending over parts of Kansas and Nebraska. Near Marshall several bridges and culverts were destroyed, and at Mexico, Mo., the rainfall was said to be the greatest ever known. Washouts occurred on the Wabash Ry. near Moberly, and a landslide blocked the Santa Fé tracks near Courtney.

Kansas.—Floods caused by the recent rains have destroyed a number of bridges in Leavenworth Co.

New York.—The worst part of the storm swept over the western part of the State. Wellsville and the surrounding country was deeply flooded by the overflow of the Genesee river, the water being from 3 to 10 ft. deep, and the flood was said to be the greatest ever known. At Rochester the river flooded some parts of the city. Around Andover and Hornellsville a number of highway bridges were carried away, the railway tracks were washed out, and at the former place the two dams at the ponds above the village gave way, the water from the ponds flooding the place. At Friendship the Erie bridge was wrecked and the gas mains broken. At Warsaw the Martinville dam was swept away and three washouts occurred on the Erie road. At Mt. Morris the greatest rainfall for several years occurred May 31. A culvert on the Dansville branch of the Erie was washed out. At Dalton the rain was the heaviest ever known; the iron highway bridge and railway culvert were carried away. At Olean, the Allegany river flooded parts of the city and broke the water main; two bridges were carried away. At Waverly the bridge on the Buffalo branch of the Delaware, Lackawanna & Western Ry. was swept away, and two of the stone piers badly damaged; washouts were also caused. In the Chemung valley, around Corning and Elmira, the floods were very serious. Washouts occurred on the Erie, and the Western New York & Pennsylvania; bridges were carried away on the latter road. At Elmira the water reached the highest point known, the Chemung being over 18 ft. above its normal level; a breach was made in the railway embankment. In the Wyoming valley some culverts and small bridges were carried away. The bridge at Corning was carried away. On the Fall Brook Ry. two bridges were swept away, and the track badly washed out between Knoxville and Westfield. At Belmont a two-span iron bridge was swept away and several persons who were on it were drowned. A bridge on the Northern Central Ry. at Watkins was destroyed.

Pennsylvania.—The worst disaster in this State was the bursting of the dam of a lake above Johnstown, the escaping flood of water sweeping away houses, bridges, and railways, wrecking towns, and causing great loss of life. Further details of this disaster will be found elsewhere. Throughout the State floods occurred. At Lewiston 8 railways and county bridges were destroyed; the water was 9 ft. higher than in 1847. At Lewisburg the railway bridge was carried away and the water and gas works flooded. A highway and wagon bridge, and several small bridges at Milton, were carried away. Newport was flooded with about 7 ft. of water. All the bridges on Tuscarora, Lost and Cocolamus creeks in Juniata Co. have been carried away, and the Juniata river bridges at Mifflinton, Mexico, Port Royal and Thomsontown in the same county; the dams, culverts, lock house and waste weirs of the Pennsylvania canal, at Mifflinton, were

also carried away. Washouts of great extent occurred on the Pennsylvania Railroad, and nearly all the roads in the flooded district suffered more or less from washouts, wrecked bridges, landslides, etc. Traffic was seriously delayed. It is thought that Northumberland Co. and Bedford Co. will each sustain a loss of $50,000 in bridges. Williamsport was flooded with 34 ft. of water in some places, the flood of the Susquehanna being 7 ft. higher than that of 1865. The rainfall is said to have been unprecedented. Harrisburg and Steelton were flooded. The trouble on the Pennsylvania Railroad was the worst ever known, some of the washouts being 300 to 400 ft. long, the tracks flooded and blocked with débris and landslides, and numbers of bridges being swept away. York Co. has lost $100 000 in bridges. At Bradford, Pa., the Allegheny river was higher than it has been for 21 years. In the valley around Mt. Carmel, the mines are being flooded, and the pumps are under water. The number of bridges wrecked by the Johnstown flood has not been given.

Maryland.—The damage in this State appears to have been only second to that in Pennsylvania. The rise of the Susquehanna flooded towns on its course and carried away immense quantities of lumber. In the Middletown valley a number of bridges were carried away. Throughout the State the railways suffered severely by washouts, and traffic was in some cases suspended. The Pennsylvania Railroad bridge over the Monocacy, near Frederick, was badly damaged, and it was reported that the only bridge left on the river was that on the Baltimore turnpike. The Susquehanna & Tidewater canal, extending from Columbia, Pa., to Havre de Grace, Md., and the Chesapeake & Ohio canal are almost ruined. The newly completed bridge over the Potomac at Point of Rocks was carried away; it had cost $75,000. It is reported that 64 bridges are destroyed, including the stone bridge over the Potomac at Shepherdstown. At Ellicott City, Frederick, and other places, the flood was the highest since 1868. Several mill dams are wrecked. The Potomac at Frederick passed the highest marks reached in the great freshets of 1852, 1870, and 1877 by from 6 to 8 ft.

District of Columbia.—The Potomac reached the highest point on record at Washington on June 2, and parts of the city were badly flooded. An investigation will be made to see if any damage has been done to the foundations of the Washington monument. Two spans of the Long bridge were carried away. Georgetown was partly flooded. Great damage has been done to the canal banks.

Virginia.—At Lynchburg the river rose to a height of 25 ft. 6 ins., the highest since 1878. The large dam of the city reservoir at Petersburg broke June 1, and two bridges were washed away: two railway bridges were also destroyed. At Richmond the gas works were flooded and the canals were damaged. A number of bridges were washed away and several washouts occurred on the railways. The dam and locks above Fredericksburg were carried away.

West Virginia.—At Martinsburg, one of the worst storms ever experienced occurred May 36. Between Piedmont and Cumberland 3 bridges on the West Virginia Central Ry. were carried away. At Rowlesburg the trestling and false work for the new Baltimore & Ohio bridge were carried away, but the old iron bridge now used was not damaged.

Louisiana.—A severe rain storm occurred in some parts of the State on May 29 and 30.

A Proposed Road Law for Georgia.

At the late Georgia road congress, held at Atlanta, the Committee on Legislation submitted the following form of a bill to be introduced at the summer session of the Georgia Legislature:

AN ACT to amend the road laws of this State and to empower the county authorities to levy and collect a tax for road purposes.

Sec. 1. Be it enacted by the Senate and House of Representatives in general assembly met, and it is hereby enacted by the authority of the same, That it shall be the duty of the county authorities having charge of the roads and revenue in each county in this State, on the first Monday in December after the passage of this act, and biennially thereafter, to appoint a Superintendent of Public Roads for their respective counties, whose powers, duties and liabilities shall be as hereinafter set forth.

Sec. 2. Be it further enacted, That said superintendents in their respective counties shall, and they are hereby authorized and required by the first Monday in February in each year to lay off the roads in their respective counties in sections as they shall deem most appropriate; the working and keeping in repair of which shall be let out to the lowest bidder on the first Monday in March for a term of one or more years.

Said letting shall be advertised once a week for four weeks in the public gazette in which the sheriff of the county does his advertising.

It shall be the duty of said superintendents to make out specifications in writing of the work to be done, which specifications shall be subject to the approval of the county authorities having charge of the roads and revenue and open to examination for four weeks prior to the day of letting, and the place where they may be found shall be stated in the advertisement hereinbefore provided for, and said specifications shall be the basis of the contract.

A bond with good security, in double the amount to be paid the contractor, shall be given for the faithful performance of the work; which bond shall be payable to the county in which the work is to be done, and be approved by the county authorities having charge of the roads and revenue before the contractor goes to work under the same. Said bond, when approved, shall be filed in the office of said county authorities. A failure by the contractor to present such bond, with good security within twenty days after the letting, shall vacate his bid, and the superintendent shall readvertise in the manner hereinbefore stated.

Sec. 3. Be it further enacted, That should any contractor fail to comply with the terms of his contract, it shall be the duty of the Superintendents of Public Roads, after thirty days' notice to the contractor, to have the road, or the portion thereof which has not been worked according to contract, worked up to the specifications of the contract by hiring hands or otherwise, as he may see fit; and the amount necessary shall be paid by the county and charged up to the contractor and deducted from the payments to be made, or recovered upon his bond.

Sec. 4. Be it further enacted, That the sums for which the work is contracted to be done shall be paid for by the county authorities having charge of the roads and revenue only when the work agreed upon has been faithfully done according to the terms of their respective contracts and the same has been certified by the Superintendent of Public Roads.

Sec. 5. Be it further enacted, That whenever it shall be made to appear to said county authorities, upon the report of the Superintendents of Roads, or otherwise, that the conditions of the bonds given under the second section of this act have been violated or not complied with, it shall be the duty of said county authorities to have suit instituted thereon, and the amount recovered shall be set apart as a road fund.

Sec. 6. Be it further enacted, That the said county authorities of any county may, if they see proper, distribute to contractors the misdemeanor convicts, under such terms as they agree on, and may reserve any portion or portions of the public roads as they can see proper to work a chain gang upon.

Sec. 7. Be it further enacted, That at the time of laying off the sections of roads as provided in this act, it shall be the duty of the Superintendents of Public Roads to assign to each section of road such hands as are available and necessary therefor, taking into consideration the length of the section, the character of work required to be done, provided that no hand shall be assigned to a section whose nearest point is more than three miles from his residence, unless the nearest road is a greater distance, in which case he shall be assigned to the nearest section to his residence. A list of the hands will be filed, with the specifications of each section; though the list will be no guarantee that the number of hands shall not be greater or less, as changes of residence of the hands or other contingencies may require.

Sec. 8. Be it further enacted, That all male persons between the ages of 16 and 50, except ministers of the gospel in charge of one or more churches, and all persons who are physically unable to work for themselves, shall be subject to work the roads such number of days as may be fixed each year by the Board of Commissioners, or ordinary, as the case may be, not to exceed eight days in the year, under the direction of the contractor of the road to which they may be assigned, and such contractor shall be charged with the amount of labor assigned to his road at the rate at which the hands are allowed to commute their labor, as provided in this act.

Sec. 9. Be it further enacted, That it shall be the duty of each road contractor at his first working to summon all the hands assigned to his road at least two days before the day upon which they are summoned to work; such summons may be verbally, if in person, or written, if left at the most notorious place of abode of the hand summoned, and the time and place of working, and the tool which is required shall be stated; provided, that no other than the ordinary farming tools may be required.

It shall be the duty of the hand so summoned, if he desires to commute his work in money, to pay the contractor the full amount of his commutation for the year in which he is summoned, and take a receipt therefor; and upon a failure either to work or pay, it will be the duty of the contractor to report the hand so failing to the Superintendent of Public Roads, who shall try the defaulter in the manner provided in this act. A failure on the part of the contractor to so report within ten days after each working shall bind the contractor for the amount of the commutation of the defaulting hand. If, at the trial before the superintendent, it shall appear that the contractor is not at fault, he shall be credited with the commutation tax of the defaulter.

Sec. 10. Be it further enacted, That it shall be the duty of the superintendents of roads to appoint a day and place for the trial of defaulters, at such time as in his judgment may best subserve the public interests, and shall have power to continue from day to day as he may see fit. The contractor reporting an alleged defaulter shall have at least five days' notice of the time and place of trial, which notice may be sent by a special officer appointed by the superintendent of roads, or by any constable of the county, whose costs shall be the same as for serving summons in civil cases in justice courts. Said notice must be in writing and served personally or by leaving at the most notorious place of abode of the person summoned. If it should appear upon the trial that the hand complained of, after being duly summoned, has failed to work as required by the contractor in a reasonable manner, or failed to bring the required tool or pay the commutation, the superintendent shall impose a fine of not less than one dollar and not more than three dollars for each day of default; and shall have power to impose an alternative judgment of imprisonment in the common jail or work upon the county chain-gang not to exceed four days for each day of default, to be computed from the time that such defaulter may be imprisoned or delivered to the chain-gang, and the special officer hereafter provided for, or any constable of the court shall have power to execute the judgment of said superintendent of roads. All errors complained of may be corrected by writ of certiorari to the Superior Court in the same manner as from a justice's court. The costs of the special officer or constable shall be paid by the contractor if it appear that he is at fault, or by the county if it should appear that a hand not subjected to road duty has been assigned to the contractor.

Sec. 11. Be it further enacted, That any person or persons who may prefer to work the road in person, or by proxy shall have the right to do so, and shall work such a number of days as may be fixed each year by the authorities, not to exceed eight days in the year, under the direction of the contractor. Any person failing to work or pay the commutation shall be subject to the penalties provided in this act. His wages shall be subject to garnishment for the amount of his fine and costs' and it shall be the duty of the superintendent of roads to proceed by execution or garnishment by summary process as provided for tax executions.

Sec. 12. Be it further enacted that said county authorities of each county in this State be and are hereby authorized and empowered to levy and collect a tax not exceeding one-fifth of one per cent. upon the taxable property of the county for road purposes, and shall assess the amount at which persons subject to work the public roads may in money commute the same.

Sec. 13. Be it further enacted that the compensation paid to the superintendent of roads shall be fixed by the Board of Commissioners of Roads and Revenue, or ordinary, as the case may be, of the county of his service, and the same shall be paid out of the county treasury.

The committee also submitted the following resolution in conjunction with the preceding act. It was unanimously adopted:

Resolved, That it is the sense of this body that the convicts of this State should be used in improving our public roads and bridges, and that this should be done as quickly as possible, with due regard to existing leases, and that the best interests of the masses of our people demand immediate legislation preparatory for such use of all convicts available now or made available in the future by the expiration or forfeiture of leases now existing. Provided, however, that exception should be made in cases of criminals who should be more cautiously and severely punished.

The Proper Design of Rail Sections.*

The subject of the wear of rails seems to have attracted an unusual amount of interest in the last six months, and in the hope of doing my share to direct opinion in what seems to me the right direction, I will attempt to discuss briefly the several ways in which the shape of the rail-section may affect the life of rails. In a paper presented at the Boston meeting of the Institute (*Trans.* xv., 594), I outlined the principal causes in the various steps of manufacture which might affect detrimentally the service of steel rails, showing that, in my opinion, the result might be algebraically represented by an equation composed of a number of variable factors, and that it was not possible to ensure a good rail by fixing any single one of these. In the present paper, on the other hand, I shall seek to prove that the design of the rail section, independent of the material used, may make a poor-wearing rail.

The design of many rail-sections by engineers who

* From Trans. of the Am. Inst. of Mining Engineers, 1889, by FREDERIC A. DELANO, Chief of Bureau of Rail and Rail-Joint Inspections, Tests and Records, C. B. & Q. R. R.

are far from being experts in the metallurgy of steel, has led to the general acceptance of erroneous principles as the rules for such designs. Until very recently, it has been assumed that the more metal there was put in the head to wear away, the longer the rail would wear; and it has been the practice, in adopting heavier sections, to put all the additional weight on top of the rail-head of a very much lighter section. Careful investigation on a number of railroads has shown that of the rails weighing 65 lbs. per yd. and over, the greater part have to be removed after comparatively trifling abrasion, solely because they are no longer fit for a smooth track. This is evidence of the error in the principles of the design of the section.

It is generally admitted that, as a rule, rail-sections designed since 1879, for rails of 65 lbs. and over, have not given entire satisfaction. There are several reasons which may account for this: first, a constant increase, during this period, of wheel-loads on engines and cars, together with generally higher speeds; secondly, new methods in manufacture, cheapening the cost of production and possibly producing an inferior article; thirdly, mechanical conditions in the rail itself, due to the shape of the rail section.

1. The first cause is undoubtedly a real one. I think there is evidence that the elastic limit of much of the rail-steel now in use is often actually exceeded by the strains of practice, causing a flow of metal which is then abraded by the wheel flanges; and the result is a kinking or a battering of the rail, which condemns it for a good track. Granting the existence of this cause, there are two ways of ameliorating the result: one is to increase the bearing-surface of wheels on rails; the other, to raise the elastic limit of the metal, which subject I shall take up later on.

2. With regard to the second cause, it is held by many that the enormous production, low cost, and "improvements" induced by competition have involved inferior quality of product. Many well-informed men are content to rest on the simple assertion that the old John Brown steel gave remarkable satisfaction, because it was made of a good iron and did not contain more than .08 per cent. of phosphorus, any analysis showing more being grossly inaccurate. If they are satisfied that this is the solution of the problem of making a really good rail, why do they not try their .08 per cent. of phosphorus? Low phosphorus steel can be made to-day with more certainty and at less cost than ever before. The only question is, whether the elimination of phosphorus is going to be worth what it costs. The fact that as many Bessemer charges are now blown in one hour as were formerly blown in a day, is pointed at as evidence that the same care cannot be given to the operation; but I think men really conversant with the turning-out of a large product will maintain that almost absolute uniformity in the iron is necessary to keep things running with the clock-work regularity required for such a rate of production. Indeed, large product and general smoothness in mill-operation are, to my mind, an indication of a uniform product, so far as metal in the rail itself is concerned, and seem to me, therefore, not objectionable on that score. With the rapid rolling, however, particularly the rapid blooming or breaking down of large ingots, I find fault, as I have explained at some length in my former paper, already cited.

3. That mechanical conditions in the rail itself, due to the general design of the rail-section, can have any important effect on the service-value of rails has not been generally admitted, so I wish to lay particular stress upon this cause and attract to it the recognition it deserves. Speaking in general terms, that form of rail is, in my opinion, faulty which has a deep, massive head, a wide, thin base, and a thin web, connected to the head and the base by small fillets only. The objection to this form and the advantages which might be obtained by different proportions, may be concisely enumerated as follows:

A. Such a form necessitates rolling at a higher temperature, and, what is of chief importance, finishing at a higher temperature than permits the securing of a well-forged, compact rail.

B. This type of section probably encourages the use of a higher percentage of manganese to reduce the number of second-quality rails; and this production of second-quality rails, as well as the additional manganese, figure in the cost of the rails to the consumer.

C. Rails with heads out of proportion to the rest of the section require a great deal more cold straightening, because it is impossible to know how much bending or cambering such a rail needs in its hot state in order that it shall cool straight. This is certainly a very important consideration.

D. The same sort of disproportion must produce corresponding disproportions in the rate of cooling, causing internal strains which are only partly dispersed or effaced by the small connecting fillets.

E. A section having these internal strains exaggerates the effect of any impurity which may chance to have segregated in the ingot, while a section not liable to these strains would safely admit of a generally higher carbon steel as well as a considerable latitude in composition.

F. It is not economical to provide for an abrasion of some ⅝ of an in., or even more, from the top of the rail, if it is found that rails generally fail long before this amount has been abraded. Instead of providing more height to wear away, we can do better by providing more breadth of bearing surface, and metal of a higher resistance within the elastic limit.

G. Inasmuch as the funnel-shaped cavity, dispersed blow-holes, and possible impurities exist in the ingot in the axis of its length, it follows that these defects will exist (especially in rails made from the upper part of the ingot) on an axial line which passes through the rail-section, and hence that if the rail-section has 50 to 55 per cent. of its metal in the head, the poorest metal is enclosed in the head, where it receives the least amount of forging; whereas, if the amount of metal in the head does not exceed 40 to 45 per cent., this poor metal occurs in the thoroughly worked web portions.

The foregoing objections seem to be so formidable and convincing that I am glad to see a general tendency among all the later investigators to come to the same conclusions. It seems to me that rail-sections should be made to certain definite proportions, regardless of the weight per yard. It is often said that the larger sections will admit the use of a higher carbon steel; but this assertion requires the proviso that the heavier section shall be similarly proportioned. One 74-lb. section which I have in mind could not be safely made of as high a carbon steel as the 62-lb. section from which it has been schemed.

While I am deeply interested in the recently published researches of Mr. D. J. WHITTEMORE, Chief Engineer of the Chicago, Milwaukee & St. Paul R. R., and agree entirely with him in his conclusions that wheels should be cylindrical and the bearing surface should be increased, it seems to me that a rail head of 12 ins. radius is flat enough. Since there is a lateral play of fully ½ in. for the average car wheel on an average track (not to mention a 4 ft. 9 in. gauge), both the wheel treads and the rail heads must wear to a curve. On the other hand, if the rail head begins with a slight top curve, it would take no longer than with the flat-topped rail to assume the curve of the average wheel. This is a subject, however, which deserves more attention than I am able to give it in the present paper. Mr. WHITTEMORE has ably argued the need of more bearing surface, which, after all, can only be obtained by widening the rail head; and I am glad to quote him here as authority for the need of wider heads for our rails. The reasons for making the head shallow, as well as wide, have been recited. For the same reasons the web and flanges should be heavy, with liberal connecting fillets.

The problem is to increase the life of rails without greatly enhancing the cost. It might be possible to make a 60-lb. rail of steel, worth $75 per ton, give as good service as an 85-lb. rail made of $30 steel; but the discovery would not prove remunerative.

With regard to internal fillets and flat fishing angles, I have held the extreme view that the fillets should be liberal and the angles of enough slope (certainly not less than 15°) to allow readily of colder rolling than is anywhere the practice in this country.

The specifications which I append as a conclusion to these brief remarks may be of interest to some, as being different in several particulars from any other rail specifications. They weredrawn up originally 15 months ago, and have not been changed in any important particular since that time.

PROPOSED SPECIFICATION FOR STEEL RAILS.

1. The steel used in the rails shall be made by the Bessemer or by the Open-Hearth process and shall not contain more than 12-100ths of one per cent. of phosphorus, as determined by an analysis made from a boring into the centre of metal of the rail-section of any rail.

2. The ingots shall be poured with care, and the moulds filled at one pouring, without undue spattering of the sides. No sand or water shall be thrown upon the ingots after pouring; but, on the contrary, coke or charcoal-dust shall be used. In no case shall rails made from a chilled heat or a bled ingot be accepted as first-quality rails.

3. Cold moulds, or moulds in such a shape as to require more than a hand-sledge to free them from the ingot, shall not be used.

4. It is preferable that ingots, when taken from the pit, should be kept erect and so heated; but if this is not the practice of the rolling mill company, the ingot shall not be laid until it is certain that the central part has solidified.

5. Blooming-rolls of 40 ins. from center to center shall not be driven at a speed exceeding 30 revolutions per minute, and larger or smaller rolls shall not be driven at a speed exceeding this in linear velocity. (The linear velocity of an ingot going through the first or 13-in. pass of a pair of 40-in. rolls, driven at a speed of 30 revolutions per minute, would be about 205 ft. per minute.)

6. No metal shall be cut from that end of the bloom which corresponds to the "butt" end of the ingot.

7. From that part of the bloom which corresponds to the top part of the ingot an amount shall be cut equalling in pounds the area of the mean cross-section of the ingot in inches, or as much more as is necessary to secure a sound pipe-free bloom.

8. The number of the charge shall be stamped distinctly on each rail and the place and date of manufacture rolled on.

9. The section of the rail rolled shall conform to the template, and a variation of more than a scant thirty-second of an inch over or under the template height shall not be allowed, and the rail must be made close enough to template to fit properly in the splice.

10. The weight of the rails per yard shall be kept as close to the standard weight per yard as can be after complying with the conditions of clause 9.

11. The rails shall be drilled for the bolts of the splice-bar, or, if necessary, notched in the flange, in accordance with the templates and diagrams furnished by the railroad company.

12. The rails shall be cut at right angles to their length, and be at 60° to 75° F., within ½ in. of the standard length of 30 ft. No shorter length rails shall be accepted by the railroad company, except under special provisions of this contract for such acceptance.

13. Rails shall be perfectly straightened in both surface and line, and without any twists, waves, or kinks. Particular attention shall be given to having the rails free from "camber," in which the ends droop, and also free from any flaws, cracks, or excessive roughness.

14. The rails shall be finished at such a temperature that it will not be necessary to allow more than 4 ins. for contraction on every 30-ft. rail sawed immediately after coming from the finishing-pass in the rolls.

15. One rail-end, which must correspond to what has been the ingot top, shall be tested for each heat or charge by a drop-weight of one gross ton, falling 10 ft. on the rail head, midway between the supports, 3 ft. apart. (The bearings are to be of iron or steel, fastened firmly to oak framing constructed of oak timbers bolted together into a solid floor, and this supported on masonry foundations not less than 4 ft. deep. The guides are to be smooth, straight, and parallel.) Should one rail-end be broken by the above test, two similar rail-ends must succeed in enduring the shock, or else cause the rejection of all rails in that same heat. It is expressly desired that the rail-steel shall contain as high a percentage of carbon as the maker is willing to put in and still produce a rail which shall endure this drop-test.

16. The representative of the railroad company shall at all times be allowed, on request, to see the *bona fide* analyses and carbon-determinations, as made by the rolling mill company, of the steel used in making these rails.

THE CITY OF SEATTLE, W. T., was visited by a great fire on the afternoon of June 6, destroying most of the business portion of the city and inflicting an estimated loss of $8,000,000. Although the city had many large and fine buildings, the majority of the structures were of wood; and the conflagration once started was entirely beyond the control of the fire department.

PERSONAL.

Hon. WARNER MILLER, of New York, was on May 20 elected President of the Carolina Oil & Creosote Co., of Wilmington, N. C. On the same day Mr. F. C. PRINDLE, M. Am. Soc. C. E., was elected Superintendent and Engineer of the same company, with headquarters at Wilmington, N. C.

Mr. R. W. BOLLING has been elected City Engineer of Montgomery, Ala., for the next two years.

Mr. J. A. NEWCOME, of Painesville, O., the builder of the Painesville & Youngstown Ry., shot himself at Clear Water, Kan., May 29.

Mr. JOHN W. HILL, of Cincinnati, O., the well known expert in hydraulic engineering, has been engaged by the City Council of Marietta, O., to prepare plans, estimates, and specifications for the new waterworks.

Mr. W. H. FRY, Master Car Builder at the Pullman shops, has been appointed Assistant Superintendent of Equipment of the Pullman Palace Car Co., with headquarters at the Chicago offices.

Mr. J. S. PATTERSON has tendered his resignation as Master Mechanic of the Cincinnati, Indianapolis, St. Louis & Chicago.

Mr. HENRY C. ALLEN, of Newark, N. J., has been appointed Assistant Engineer on the new Croton Aqueduct, with a station at Yonkers.

Mr. BENJAMIN BAKER was in this city this week for a day, en route from Nova Scotia, where he has been examining progress on the Chignecto Ship Railway, of which he is Consulting Engineer. He was urged to go to Panama, to examine and report on the feasibility of putting a ship railway across on the route of the Panama Canal, but declined. He has entire faith in the North River tunnel project, of which he is now Consulting Engineer, but not in the Haskins method of driving it, preferring rather to drive it as if it were through soft mud and wate throughout.

Mr. J. T. FANNING, M. Am. Soc. C. E., of Minneapolis, Minn., the expert in hydraulic engineering, has been engaged by the city of Winnipeg, Man., to investigate and report upon the utilization of the water power of the Assiniboine river, in connection with a proposition for the city to control this water power.

Mr. FELICIAN SLATAPER, of Pittsburg, Chief Engineer of the Pennsylvania Company, has returned from a six months' trip abroad. Some time ago Mr. SLATAPER, while inspecting the Tuscawaras tunnel on the Cleveland & Pittsburg Railway, received an injury to his left leg, from which a tumor resulted. His trip abroad was for the purpose of having an operation performed by an eminent Austrian surgeon. The operation was a complete success and Mr. SLATAPER is again able, to engage n active work.

A MODEL FARM is a new idea in railway enterprise which has been developed by the Georgia Southern R. R. running from Macon, Ga., south. The farm is intended mainly to show what can be done on the soil and in the climate of that section. But it is expected it will serve another purpose, as a model farm for the farmers already living in that section. It is hoped, says an exchange, that it will teach them new ideas, afford them new incentives, and lift them out of the rut of one-cropism upon the high plane of diversification and prosperity. The Canadian Pacific Railway has also established farms every 10 miles along its line in the "debatable land," with the somewhat different idea of practically testing the value of this land for agricultural purposes.

THE ABT RACK-RAIL SYSTEM for railways with steep grades has been endorsed in this country by the award by the Franklin Institute of the John Scott legacy premium and medal to Herr ROMAN ABT, of Switzerland. The sub-committee of the Committee on Science and Art, in recommending this award, stated that this is not a project but a well developed system which has been in successful operation for several years, and represents a marked improvement over former systems for overcoming steep grades by means of rack-rails, whereby the serious defects of these other systems have been removed.

CORRESPONDENCE.

Skew Portals.

EDGE MOOR, May 20, 1889.

TO THE EDITOR OF ENGINEERING NEWS:—

Some weeks ago I sent you formulæ for finding the three bevel angles required in figuring a skew portal.

In this week's issue I note that Mr. LIPPERT gives formulæ for obtaining one of these angles in terms of lines instead of in functions of angles. As this may be considered more convenient by some, I have put the other two formulæ in terms of known lines too, with Mr. LIPPERT'S notation.

Mr. LIPPERT'S formula for β, which is the same angle that I designated B, is

$$Sin\ \beta = \frac{b}{h}$$

substituting the value of b this becomes

$$Sin\ \beta = \frac{s\ m}{h\ \sqrt{(w-2f)^2 + s^2}}$$

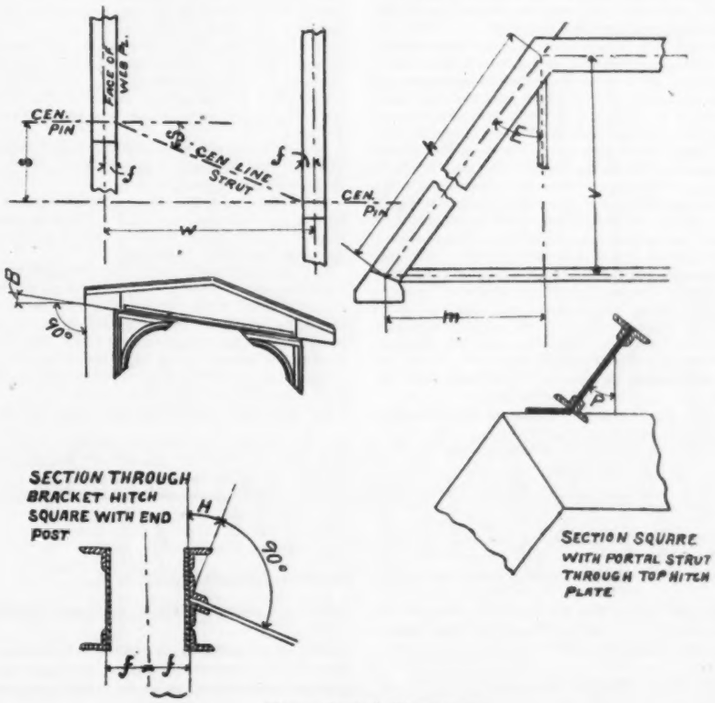
This is the most convenient form in which to use it, the terms being all known at the beginning of the discussion.

Our formula for $Sin\ B$ was

$$Sin\ B = Sin\ S \times Sin\ E.$$

By reference to accompanying sketch, in which Mr. LIPPERT'S notation is used, it is seen that

$$Sin\ S = \frac{s}{\sqrt{(w-2f)^2 + s^2}}$$



Skew Portal Diagrams.

$$Sin\ E = \frac{m}{h};\ Sin\ B = Sin.\ S \times sin\ E = \frac{s\ m}{h\ \sqrt{(w-2f)^2 + s^2}}$$

$$\text{Similarly } Tan\ H = Tan\ S \times Cos\ E = \frac{ws}{h\ (w-2f)}$$

$$Tan\ P = Tan\ E \times Cos\ S = \frac{m\ (w-2f)}{v\ \sqrt{s^2 + (w-2f)^2}}$$

v is the vertical height center to center of pins.

Yours truly,

M. J. PATTERSON.

Snow Sheds and Glance Fences—Correction.

Canadian Pacific Ry., VANCOUVER, B. C., May 20, 1889.

TO THE EDITOR OF ENGINEERING NEWS:—

My attention has been called to a letter in your issue of May 11, over the signature of Mr. CHARLES A. STOESS, and as this letter contains several misstatements of facts I will ask for sufficient space to correct them, as briefly as possible.

In regard to the commencement of the snow sheds in November, 1885, which Mr. STOESS refers to, Mr. GEORGE ELLISON was engineer in charge of that work, which consisted of one or two pieces of cribwork built partially up the slope of one of the cuttings, and the portion of it that did not tumble down in the spring had to be taken down before the permanent sheds were built. Mr. J. H. ARMSTRONG was then put in charge of the work as engineer, and Mr. STOESS, who claims all the credit of the snow shed designs, was his draughtsman and office-hand. Mr. ARMSTRONG submitted a number of designs for snow sheds, which were probably drafted by Mr. STOESS, and, after consultation with the then Vice-President, Mr. VAN HORNE, these designs were approved of with some modifications and changes.

Mr. STOESS continued to act as Mr. ARMSTRONG'S draughtsman, during part of the summer of 1886, and I think it would surprise that experienced engineer very much to learn that the plans he submitted for approval were *designed* by that gentleman.

In the spring of 1887, Mr. STOESS was placed in charge as engineer of the snow sheds to be erected during that season, under direction of my Superintendent, Mr. MARPOLE, who had entire charge of the location and construction of snow sheds, cribs, and glance fences, and took his instructions from me. Mr. STOESS' duties were to prepare plans in accordance with designs and instructions furnished him, lay out structures where directed, furnish bills of quantities, superintend details, and make estimates for the contractors. I am thus particular in defining his duties because they were somewhat limited, and I was careful to allow him no discretion as regards the character of the works.

Early in the season I submitted a statement to Mr. VAN HORNE of the length of shedding required, and shortly afterwards, before any work was commenced, he made a trip over the line, examined all the localities carefully, and instructed me to shorten many of the proposed sheds and to build glance fences and cribs to guide the snow to the sheds or otherwise, and at a great many points where I had recommended putting in sheds, rough sketches were made by Mr. VAN HORNE and myself and given to Mr. STOESS, with verbal instructions regarding designs for these structures.

A different system from the previous year was also then decided upon at the suggestion of myself and Mr. MARPOLE, my assistant, for the construction of some of the sheds, the plan of building cribs a portion of the height of the cutting and carrying gallery sheds up the face of the slope on posts being adopted in place of solid cribs to the full height, for which Mr. STOESS was also instructed to make plans from rough sketches and verbal instructions given to him.

I now come to the most remarkable feature of Mr. STOESS' letter. It will be observed that he takes credit for all the designs of the present snowsheds (except solid cribs), and more especially for the glance cribs, fences, and split fences, and I have shown above that he was merely employed as draughtsman under other engineers, during the time that he claims to have designed the former of these works.

As regards the glance cribs and fences, not only had he nothing whatever to do with designing them, but Mr. MARPOLE had to report him to me, and I had actually to threaten him with dismissal, before he could be induced to carry out Mr. VAN HORNE'S ideas and designs, furnished to him through me; he having condemned them and spoken of them, to me and others, as work which he would not be responsible for and could not approve of.

I may further remark that the fence Mr. STOESS characterizes as the "Canute" fence, which was intended to stop a portion of the "fan" of a slide, has stood several severe shocks, has done well what was expected of it

and stands to-day as sound and good as the day it was built. The fact is that the inventive genius of Mr. STOESS has been confined entirely to the invention and circulation of contemptuous terms, such as those referred to in your editorial in reply to his most remarkable letter.

I may state in conclusion, that what I have said is susceptible of proof by several of the reliable employés of the company and by the documents in possession of the company, but I do not consider the matter of sufficient interest to the public generally to justify taking up any more of your valuable space, or again referring to it.

Yours truly,

H. ABBOTT,
General Superintendent.

[The above corresponds precisely with information gathered by the editor on the spot, not only from officers but from employés, and we think may be regarded as final and decisive.—ED. ENG. NEWS.]

New and Heavy Rolling Loads.

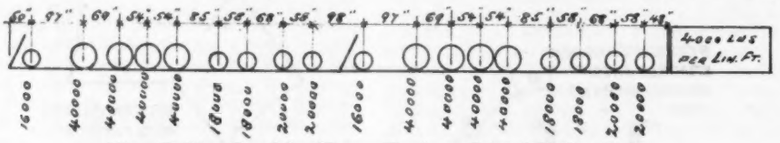
Rochester Bridge & Iron Works,
ROCHESTER, N. Y., May 28, 1889.

TO THE EDITOR OF ENGINEERING NEWS:—

In your editorial comment of March 25 upon Mr. B. BAKER'S advocacy of providing for the contingency of train accidents upon bridges occurs the sentence, "Already, we learn, one great road at least has now under contemplation a further increase in assumed loads by specifying 10 tons per wheel as the typical load for consolidation engines." I presumed that the driver wheels were the wheels referred to, and so thought it might be interesting to some of your readers to know that such a loading had actually been specified, and accordingly I enclose a diagram of such loading, as incorporated in the Lehigh Valley R. R. specifications. This specification was received by this company March 2, 1889, and bridges proportioned for this load are now being built in these shops. I know of nothing that will show the effect of this loading better than to say that it produces an end shear of such extent as to necessitate a web sheet ½ in. thick in a deck plate girder span, single track, 45 ft. extreme length, and 3 ft. 9¼ ins. out to out of angles, the unit strain for shear in webs being 4,000 lbs. per sq. in.

Yours truly,

ALFRED M. MOSSCROP.



New Rolling Load for Heavy Engines, Lehigh Valley R. R.

[The Lehigh Valley was the road we referred to, although we did not feel at liberty to mention it specially.—EDS. ENG. NEWS.]

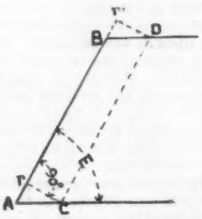
Skew Portal Solution.

COVINGTON, KY., May, 24, 1889.

TO THE EDITOR OF ENGINEERING NEWS:—

The following is a short and easy way to solve the "Skew Portal Problem."

To transform a square portal *A B* having an elevation of *E* degrees into a skew portal having one side a given distance (*A C*) in advance of the other. Raise the side to be advanced to *r r* and bent to *C D*, then *A r* ÷ length of



the skew portal gives the bevel of the portal and *r c* ÷ length of the square portal gives the bend. *A r* = sine of *E*, *r c* = sine of *E*, and *A C* = radius of *E*. *A C*, *E* and the length of the square portal is known.

Yours truly, CLARK BROWN.

A Correction.

KANSAS CITY, MO., May 27, 1889.

TO THE EDITOR OF ENGINEERING NEWS:—

Will you allow me to correct the statement made in your last issue to the effect that I have been appointed Superintendent of Construction for Kansas City? My name was sent in for approval of the Council, but owing to a deadlock, it, with nearly all others, was not confirmed. With the adoption of our new City Charter the matter now rests with the Board of Public Works, which as yet has not been appointed.

Yours truly,

KENNETH ALLEN.

The Colorado Canon Survey.

GREEN RIVER, Utah, May 24, 1889.

TO THE EDITOR OF ENGINEERING NEWS:—

The engineering party intending to make a railway survey down the Colorado river, reached this place last night. The party consists of President F. M. BROWN and Chief Engineer R. B. STANTON, with 16 assistants, including a photographer and a geologist.

The party expects to start for the head of the Colorado at once. It is just 20 years ago to-day since Major ROWELL started from Green River, Wyo., on the first exploration of these rivers.

The party will go from here down the Green river in six boats, five of them being light cedar boats, 15 ft. in length, with copper air-tight compartments in either end and a water-tight cabin in the center for provisions. These boats were built in Chicago. The sixth boat is a flat-bottom, open boat, built at this place. The survey will commence at the mouth of the Green and Grand rivers, there taking up the line just completed down the Grand river, from Grand Junction, Col., on the Denver & Rio Grande Ry. This line makes the distance from Grand Junction to the mouth of the Grand and Green 160½ miles, with a total fall in the river of 782 ft.

According to this survey, made by Mr. F. C. KENDRICK, there will in no place be a grade to exceed 10 ft. per mile.

The work will not be remarkably heavy in any part of the line. Two tunnels, of some 2,000 to 2,500 ft. each, will save a distance of some 10 miles.

The remainder of the line consists of ordinary river line bluff work, with very few rock cliffs; some portions, on smooth river bottoms, being as smooth and beautiful as the valley at Grand Junction.

The valley of the Little Grand, 100 miles from Grand Junction, is 12 miles long and 2 miles wide, in which is the town of Moab, Utah. This valley is covered with rich farms, on which are raised varied crops; among them being cotton, figs, tobacco, and at many points along the Grand river figs are being successfully cultivated.

The character of the rock through this whole section is sandstone and not difficult to work.

Mr. KENDRICK thinks the curvature can be kept as low as six degrees without materially increasing the work.

S.

[We shall hope to be able to give further details later of this interesting survey through one of the greatest wonders of the globe.—ED. ENG. NEWS.]

The Memphis Sewerage Systems.

NEW YORK, May 29, 1889.

TO THE EDITOR OF ENGINEERING NEWS:—

Fearing that your readers are already surfeited with the discussion on the Memphis sewerage system, I hesitated somewhat before replying to Col. WARING'S letter on page 483. But as the real issue is not a personal but a professional one, I enclose a reply, and will first refer to the partially personal matter. My letter to you of Jan. 21, 1884, which gave rise to some of Mr. BALDWIN'S statements, was written from notes taken by me during a visit to Memphis, when I was shown over the works by Mr. A. Ross, Superintendent of Sewers (Col. MERIWETHER was not in town), and who very freely expressed his opinions. It was he who said that they were adding manholes whenever they could and would like them at every intersection. That they did continually add manholes is shown by the official reports.* And that they wanted them at every intersection is proven by the fact that in the new Chelsea system they are so placed. Mr. Ross' statement was, therefore, correct, and my report of it true, and I see no contradiction to it in the quotation from Mr. BALDWIN'S report upon that point, without Col. WARING'S illumination.

Mr. Ross likewise said that the main sewers were gorged during the storms, and that without the overflows there would be much trouble at such times, but said nothing about leaving taps running in freezing weather. Mr. BALDWIN states in a paragraph *between those which are quoted* by Col. WARING: "*Rainwater.*—The flow of water in sewers is perceptibly increased in time of rain. The rise and decline are so sudden as to make it appear that water enters directly from roofs and yards rather than by seepage from the ground." Mr. Ross's statement to me is, therefore, confirmed by Mr. BALDWIN. If overflows were necessary during storms, why say that they were put in for relief *only* during freezing weather, when I doubt not, they were also necessary?

I do not remember what particular 8-in. pipe Mr. Ross showed me, but I do remember his saying that he would be much better satisfied if all laterals were 8 ins. That this statement also had a good foundation is proven by the fact that the minimum size for the new Chelsea system has since then been fixed at 8 ins.; in other words, the use of 6-in. laterals has been abandoned.

As it takes so little to change the Waring system to the ordinary separate system, and as these slight changes had been made accidentally and unavoidably by admitting some roof water, and partly on purpose by the addition of manholes; remembering, also, that Mr. Ross said the saddle piles and conical junctions, (novelties in Col. WARING'S patent), would not be used again; I wrote for these reasons that the present successful working was not due to any novel features, but rather partly to their abandonment, and partly to good management.

I have little, if any, interest in the above, but I feel considerable interest in the professional aspect of this question. After having spent several months of 1880 in England, gathering facts and opinions concerning the separate system from a number of engineers, and after reporting my conclusions to the National Board of Health, in 1881, it struck me as a very peculiar proceeding when Col. WARING took out a patent on such a system of sewers, the essential principles of which had been long ago discussed by Englishmen and at the time of my visit in my presence. I therefore feel it to be my duty, particularly as a member of the Institution of Civil Engineers, to give them publicly the credit of originality that was plainly due them.

If there is some slight legal technicality which really grants Col. WARING the patent, it is to be regretted in the interest of professional engineering. But whether such a patent is valid or not, simple justice compels me to say that the *principles* claimed as "undeniably original" were suggested before, as shown by your own quotations in last week's issue, and as I remember from numerous conversations I had in England. I heard more than one borough engineer say that he would, of course, have preferred to exclude all rain-water, to lessen the cost of sewage treatment. I think it was Mr. WHITE of Oxford, who said that he actually did exclude it from one particular sewer. But the inconvenience to property holders by preventing the underground drainage of back roofs and back yards, and on the other hand, the advantage of the cleansing effect from such slight addition of rain-water for branches, and particularly for mains, made it preferable not to be too rigid in the exclusion. But the fundamental principle of the separate system was recognized to be absolute exclusion, and they endeavored to get as near to it as practicable.

Concerning flush tanks, I heard it said that they would like to have them, and did have them in certain places, but that they generally preferred to flush by hand, because the automatic tanks require more water, and the water supply in England is less abundant than in American cities. But here again, the *principle* of flushing sewers automatically was recognized, and was carried out, wherever preferable to other means.

Respectfully,

RUDOLPH HERING.

* Maj. HUMPHREYS, July, 1881, says after the works were completed: "The system is without manholes except a few on the main sewers." I was told there were about half a dozen. According to Col. MERIWETHER'S report of last year, there are now 86 manholes, a few of which are on the old sewers. The flush tanks naturally did not clean the mains, and the necessity for subsequently adding manholes was greater on the mains than on the laterals.

SOCIETY PROCEEDINGS.

American Society of Civil Engineers.—The regular meeting was held June 5; Vice-President FTELEY in the chair.

The Secretary announced the deaths of Mr. ADNA ANDERSON and Mr. CHAS. A. MARSHALL. The latter was engineer of tests for the Cambria Iron Co., at Johnstown, Pa., and his name is in the published lists of persons killed in the late disaster at that place.

Mr. FTELEY in referring to this disaster, which was caused by the breaking of a dam, said that it had been attributed to the failure of an engineering structure, and as in 1874 the Society appointed a committee to investigate and report upon a similar but less serious case, in Connecticut, he thought it would be proper for the Society to follow the same course now. After some discussion the following members were appointed a committee of four to investigate the cause of the Johnstown disaster: Mr. M. J. BECKER, Mr. A. FTELEY, Mr. JAS. B. FRANCIS, and Mr. WM. WORTHEN. Mr. FTELEY stated that he had been directed by the Aqueduct Commissioners, of New York, to investigate the case and make a report to them.

Mr. SHINN gave the following particulars, from the best information obtainable at Pittsburg. The dam at South Fork was about 1,000 ft. long, 70 ft. high, 300 ft. wide at the base and 50 ft. on top; the waste weir was about 75 ft. long and 4 ft. below the crest of the dam. An engineer named PARKE had been engaged in carry-

ing out some drainage work near the dam, and had noticed no cause for apprehension when he retired on Thursday night, but on Friday morning he found that the state of affairs had changed, and that a flood was imminent. A force of men was put to work to dig a ditch through the shale at one side of the dam to form an outlet, but the water in the reservoir continued to rise at the rate of 9 to 12 ins. per hour. Mr. PARK then rode to the South Fork station, on the Pennsylvania R. R., 3 miles distant, and gave the alarm, which was heeded. He also telegraphed to Johnstown and the other towns in the valley, but there had been so many false alarms at former times that little attention was paid to the warning. At Johnstown the water from Stony Creek and the Conemaugh river had flooded the lower part of the city in the morning, as had often been the case before. Between 2.45 and 3.15 P. M. water began to go over the crest of the dam, and was soon 1 to 3 ft. deep on the crest; there was therefore no giving way of the dam under the pressure, but by the denudation of its face by the wash of the water it became so weak that it broke; the breach was 200 or 300 ft. wide, extending to about two-thirds the depth of the dam from the top, and below that a narrower breach went right to the bottom. In 45 minutes the pond was empty. The pond or lake was 3 miles long, 1,000 to 3,000 ft. wide, and 20 to 70 ft. deep. The dam was originally built by the State to impound water for the Pennsylvania canal from Johnstown to Pittsburg, and he thought it had been raised, but was not sure. It had been examined several times and pronounced safe, and in fact it was safe in all ways except in the provision for overflow. The stone arch bridge of the Pennsylvania R. R. across the Conemaugh at Johnstown was built about a year ago to replace an iron structure; it remained intact, but served to stop the floating débris, which became piled up so as to form a dam, turning the current of the river to one side, where it breached the railway embankment and flowed down to the Cambria Iron Works. The statement made that the dam was of masonry was incorrect; the original dam built by Gen MOREHEAD was of masonry, but it was carried away before the canal was in use, and it was rebuilt by the State.

Mr. BRENDLINGER stated that he had seen the dam in 1880, and there was a large breach in the middle which was being filled by dumping in hard shale blasted from a cut in the side hill in the same way as a railway embankment is made; the dam was faced with loose stone. He had not thought the method of repairing a good one, and had talked to Mr. PEARSON, the engineer in charge, but the latter had stated that the work was good enough. The waste-weir was 75 ft. wide, and cut out of the solid rock. The people at Johnstown and in the valley were indignant at the rebuilding of the dam. There were considerable leaks at the base. From Mr. SHINN's description, it seemed to him that it was this new portion which had gone out. He thought the dam was less than 1,000 ft. long, about 25 ft wide on top, and 100 ft. high. The water was then 30 ft. deep, being up to the bottom of the breach.

Mr. NORTH thought the first dam had been built about 1840 by Mr. MORRIS, who considered this a good site having solid rock for the spillway. The dam was to be 850 ft. long on top and 70 ft. high; it was to contain 100,000 cu. yds. of stone and and rock, and 110,000 cu. yds. of earth. The capacity of the reservoir was to be 480,000,000 cu. ft.

It was stated, but not confirmed, that the original dam was of masonry, and was torn down when the canal was discontinued, for fear that some day it might break.

Mr. FTELEY referred to his experience with dams in Massachusetts and Rhode Island. In one case an earth dam 25 ft. high, with a 4-in. concrete heart wall, had stood for 25 years. In another case the pressure of a long flat-sloped earth dam had pushed the stone front wall over so that the overhang at the top was 2 or 3 ft. In yet another case an earth dam had been built on the surface of the ground, without removing the turf from the surface except for a strip 25 ft. wide under the middle of the dam.

Mr. STARLING's paper on the Mississippi river was laid over for the convention. There will be no meeting June 19.

The following candidates were elected:

MEMBERS.

MARTIN GAY, West New Brighton, N. Y.
JULIEN A. HALL, First Asst. Eng., Richmond & Danville R. R., Washington, D. C.
FRANK NEARING, Chf. Eng. for Brown, Howard & Co., New Croton Aqueduct, Tarrytown, N. Y.
GEO. S. PIERSON, City Engineer, Kalamazoo, Mich.
ARTHUR B. STARR, Supt. Eastern Div., Pennsylvania R. R., Allegheny, Pa.

ASSOCIATES.

JULES BREUCHARD, Contractor, New York.
KIOSABURO FUTAMI, Kansas City, Mo.
JOHN V. HAZEN, Prof. of Engineering, Hanover, N. H.
MILLARD HUNSIKER, Carbon Iron Co., Pittsburg, Pa.
FRANK C. LEWIS, Mt. Vernon Bridge Co., Mt. Vernon, O.

JUNIORS.

WM. C. CUSHING, Zanesville, O.
THOMAS F. LAWLOR, Poughkeepsie, N. Y.

American Society of Civil Engineers.—Annual Convention of 1889. The Convention will be held at Seabright, New Jersey, beginning on Thursday, June 20, 1889. Seabright is on the Atlantic coast, a few miles north of Long Branch and is within one hour's time of New York, by rail or boat. The President of the Society, Mr. M. J. BECKER, will deliver the annual address.

The headquarters of the Society will be at the Octagon House, rates $3.00 per day. The round trip fare between New York and Seabright is $1.35. The committee has arranged for excursions on Pleasure Bay, drives to Long Branch and other points. The Trunk Line Association, the Central Traffic Association and the Southern Passenger Association, have arranged that persons residing in their territory by paying full first-class fares to New York, will be returned at one-third full fare from New York. The New England Passenger Committee returns travelers at half-fare. No replies have yet been received from the other passenger associations. Tickets must be purchased to New York within three days before or two days after June 20. Return tickets must be purchased within three days of the close of the Convention on production of certificate issued with original ticket. Messrs. CHARLES MACDONALD and T. C. CLARKE are the committee.

At the Annual Convention at Seabright, N. J., June 20, 1889, the following papers will be presented:

"American Railroad Bridges," THEODORE COOPER. "The Sibley Bridge," O. CHANUTE, W. A. BREITHAUPT and JOHN F. WALLACE. "Timber Trestle Bridges for Railways," ONWARD BATES. "Componential Trusses for Travelling Crane," HENRY B. SEAMAN. "The Improvement of Railway and Street Railway Track," E. E. RUSSELL TRATMAN. "Metal Track for Railways," E. E. RUSSELL TRATMAN. "Wheels and Rails," G. LEVERICH. "Development of the American Rail and Track," E. E. WATKINS. "The Settling and Filtration Basins of the Vicksburg Water-Works," CLARENCE DELAFIELD. "Some Maximum Rainfalls in Boston," DESMOND FITZGERALD. "Ship Canals," R. E. PEARY.

The following papers, not yet published in Transactions, are also to be discussed. Proof slips or abstracts of either of these will be sent to members who desire to discuss them.

"On the Fresh Water Algæ and their Relation to the Purity of Public Water Supplies," GEORGE F. RAFTER. "Cylindrical Wheels and Flat-topped Rails for Railways," D. J. WHITTEMORE. "The Construction of the Bridge over the Arkansas River at Van Buren, Ark.," C. D. PURDON. "On Flood Heights in the Mississippi River, with especial reference to the Reach between Helena and Vicksburg," WILLIAM STARLING.

A final report from the Committee to Consider the proper Relations to Each Other of the Sections of Railway Wheels and Rails.

JOHN BOGART, *Secretary.*

Engineers' Club of St. Louis.—The regular meeting was held May 29; President MEIER in the chair, 19 members and 5 visitors present.

Mr. P. M. BRUNER read a paper on a new system of "Fireproof Flooring." He explained the requirements of the modern fireproof building, and showed the objections to some of the most prominent systems in use. A number of tests had been made on the new flooring with excellent results. It had been used in the State capitol at Jefferson City, and was now being applied in some St. Louis buildings. He also gave detailed particulars regarding manufacture, erection, durability and cost. Prof. JOHNSON, Col. MEIER and Mr. MOORE took part in the discussion.

The special order of the day was then taken up, being a discussion of Mr. SEDDON's paper on "Settling Water." Prof. JOHNSON presented a written discussion based on his recollection of the paper as read. He criticized at some length some of the methods employed and the results secured, and also gave credit for certain data which the paper contained, and which, in his opinion, were of great value. He thought the disturbing effect, due to the energy imparted to the water on entering the basin, and also the effects of the wind, were greatly underestimated. He also explained what he considered to be the advantages of the plan of continuous settling and of covering reservoirs. Mr. HOLMAN explained the experiments on this subject made by Col. FLAD several years ago, which had resulted in unfavorable conclusions. The principal difficulty with St. Louis water was due to the fact that the reservoirs could not be cleaned as often as necessary; and, furthermore, they were required to do about double the work which they were originally intended for. Mr. HOLMAN also gave some particulars of the different kinds of sediment contained in the water at different seasons of the year. The sediment from the Mississippi was very different from that from the Missouri river. He stated that the Missouri river water was always more impure than the Mississippi. Col. MEIER, Mr. ROBERT MOORE, Prof. GALE, Mr. SEDDON and Mr. FERGUSON also took part in the discussion.

WM. H. BRYAN, *Secretary.*

Engineers' Society of Western Pennsylvania.—A regular meeting of this Pittsburg society was held May 21; President J. A. BRASHEAR in the chair. Mr. LOUIS S. CLARK gave an interesting history of the inception of the idea of fixing sound and the progressive steps to the present graphophone, illustrating his remarks by blackboard sketches and by the exhibition of the instruments, which were given a practical trial. It was said that as yet its main use is to take the place of the stenographer; its record is correct, and if the typewriter errs he can go back to the graphophone and find its error. It is a wonderful invention, and no one can say what its future may be.

S. M. WICKERSHAM, *Secretary.*

The Pennsylvania Sanitary Convention, under the auspices of the Pennsylvania State Board of Health, was held in Pittsburg last week, with about eighty persons in attendance. Mr. WM. METCALF presided, the secretary was Mr. GEO. L. MCCOY, and the list of vice-presidents included many prominent names, among them Messrs. B. F. JONES, JOHN DALZELL, M. C. QUAY, M. K. and W. J. MOORHEAD, etc. The professional papers read were as follows:—"Dyspepsia, a Study in Personal Hygiene," by Dr. FRANK WOODBERRY; "Cellar Air in Homes," by Dr. E. H. SUPPLE; "Fermented Beverages of Low Alcoholic Strength, commonly known as Soft Drinks," Dr. LEFFMANN; "The Future of Our Rivers as Sources of Water Supply," by THOS. P. ROBERTS, Chief Engineer of Monongahela Navigation Co.; "The Selection and Treatment of Water Supplies," by Dr. LEFFMANN: "The Proper Mode of conducting a Sanitary Inspection," WM. B. ATKINSON: "Importance of Vital Statistics from a Physician's Standpoint," by Dr. G. E. ABBOTT; "A Plea for Public Health Work in Villages," by Dr. H. B. BAKER; "Adulteration of Food and Drugs," by PERCY F. SMITH. The annual address was delivered by Dr. JACKSON PIPER, president of the State Board of Health of Maryland.

RAILWAYS.

EAST OF CHICAGO.—Existing Roads.

Maine Central.—Nearly 3 miles of track has been laid on the 10 mile branch from Fabyan's to Scott's and work is being rapidly pushed on the remainder.

Grafton & Upton.—About 300 hands are now at work on the extension to Milford. The line is to be completed by Oct. 1.

Toledo, Columbus & Springfield.—Articles of incorporation of the reorganized Toledo, Columbus & Southern Railway Co. have been filed in Ohio. The road is to be extended from its present terminus to Columbus, O. The incorporators are: CHAS. HICKOX, A. T. INGERSOLL and others of Cleveland, Ohio.

Detroit, Wabash & Chicago.—The cities of Peru and Wabash, Ind., have voted $85,000 in aid of this line running from Wabash to a connection with the Wabash Ry. at Laketon, Ind.

Philadelphia & Reading.—The preliminary survey of the branch from Lofty, Pa., to the Lehigh coalfields, a distance of about 25 miles, has been completed.

Western Maryland.—The extension of the Baltimore & Harrisburg R. R. from Fairfield to Blue Ridge, 11 miles, has been completed and opened for traffic. The line from Ortanna to Fairfield, 4 miles, was completed last year.

Buffalo, Rochester & Pittsburg.—Track laying on the Rochester & Glen Haven R. R. has been completed and the road will be opened for traffic June 11.

Wheeling & Lake Erie.—Surveyors are at work on the line from Portland to Steubenville, O.

Boston & Maine.—Surveys are reported in progress for a road to be known as the Stoneham & Fells R. R., to run from a point on the main line near Fells to Stoneham, Mass.

Pennsylvania.—The contract to build the Maryland Midland R. R., which is to run from a point on the Green Spring Branch of the Northern Central R. R., between Rogers Station and the junction of the Western Maryland R. R., along the Caves Valley and Worthington Valley, a distance of 25 miles, has been let to Ryan & McDonald, and construction will begin at once. The road will be equipped and managed by the Pennsylvania R. R. Co.

Concord.—A protest has been made by the minority stockholders of this company against the recent contract with the Boston, Concord & Montreal R. R., on the plea that it is unlawful and detrimental to the best interests of the road.

Cleveland & Canton.—The Coshocton & Southern R. R. has been completed from Coshocton to Zanesville, O., 30 miles, and will be opened for business June 15.

New York, Lake Erie & Western.—The surveys and estimates have been made for the extension of the New York & Greenwood Lake branch of this road, from Orange, N. J., making a loop around all the Oranges and connecting with the main line again near Watsessing.

Wilmington & Northern.—An extension 3 miles long

from Wilmington, Del., to a new ferry pier on the river will be built this summer.

Old Colony.—Work is being pushed on the branch from North Attleboro to Walpole, Mass., a distance of 11 miles. About 300 men are now at work on the line.

Pittsburg, Shenango & Lake Erie.—At the annual meeting of this company recently held, the following report of operations for 1888 was submitted:

	1887.	1888.
Gross earnings	$196,821	$227,248
Expenses	147,888	146,065
Net earnings	$48,933	$81,183

The following officers were elected: F. W. HUIDEKOPER, President; A. H. STEELE, Vice-President; P. E. MCGRAY, Secretary; DANIEL MOORE, Treasurer, and W. G. SARGEANT, Purchasing Agent. Negotiations are now pending looking forward to the early building of the line from Osgood, Pa., to Conneaut, O., 45 miles.

Canadian Pacific.—A correspondent informs us that the Government has three parties of engineers in the field surveying the proposed Short Line from Harvey to Salisbury, N. B. Two of these are working east and west from Frederickton, N. B., and one, west from Salisbury. The object of the road is to obtain direct railway connection between Montreal and Halifax, and it will be operated in connection with the Canadian Pacific R. R. The maximum grade is to be 1 per cent., and the maximum curve 6°. VERNON SMITH, C. E., has charge of the surveys.

Long Island.—About 3½ miles of track has been laid on the 4-mile extension to Oyster Bay. It is expected to have the road open for traffic by June 24.

Projects and Surveys.

Sandusky, Columbus, Lake Erie & Southern.—CHARLES A. JUDSON, of Sandusky, O., Chief Engineer, has sent us the following:

The surveys began June 3 on this proposed road which is to run from Sandusky via Bellevue and Bucyrus to Columbus, O., a distance of 110 miles. No effort has yet been made to secure the right-of-way or other local aid. JNO. MCKELVEY, of Sandusky, is President.

Easton & Northern.—Incorporated in Pennsylvania to build a line of railway from Easton, Northampton county, Pa., to Ashland, in the same county, a distance of 10 miles. The officers of the company are: J. T. KNIGHT, President; FRED GREENE, Secretary; and PETER BRADY, Chief Engineer. Work is reported begun at Ashland by the contractor, James Smith.

Boothbay & South Newcastle.—H. A. HANCOX, of Hudson, Mass., Chief Engineer, has completed the survey of this road running from Boothbay Harbor to South Newcastle, Me., a distance of 12½ miles.

Fort Montgomery Switchback.—Engineers are at work surveying a switchback railway to run from Jones Point, a short distance south of Fort Montgomery, N. Y., to the top of Mount Dunderberg. The length of the road will be about 10 miles.

Troy & Sand Lake.—A project is being agitated by the citizens of Troy, N. Y., to build a railway from Troy via Sand Lake and Nassau to Chatham, a distance of about 15 miles.

Columbus Belt and Terminal.—This company has been organized to build a belt line around the city of Columbus, O. B. C. FAUROT and F. L. LANGDON, of Columbus, are among the incorporators.

Sandusky, Ashland & Coshocton.—The contract for building 18 miles of this road from Sandusky to Norwalk has been let to Keating Bros., of Pittsburg, Pa. The road is projected to run from Sandusky to Coshocton, O., a distance of 120 miles. It is claimed that $500,000 local aid has been secured. The company's headquarters are at Sandusky, O. G. C. GARDINER is President and J. OWEN CRANE is Secretary.

George's Valley.—The National Construction Co., 2 Wall St., New York, has offered to build this road from Warren to Union, Me., a distance of 8 miles, for $5,000 per mile in cash, $5,000 per mile in bonds, $5,000 per mile in stock. The road will ultimately be extended up the George's Valley to a connection with the Maine Central R. R. H. A. HANCOX, of Hudson, Mass., is Chief Engineer.

Castine & Bangor.—It is stated that this company has secured control of the Penobscot Central R. R. and will build the entire line from Castine to Milo, Me., as soon as $100,000 has been raised by the people along the route. JAMES ADAMS, of Bangor, Me., is President.

SOUTHERN.—Existing Roads.

Kanawha.—This road which runs from Stevens' Mines to Fairfield, Va., 10 miles, is to be extended 9 miles further up Cabin creek. C. D. Langhorne, of Richmond, Va., has the contract and is rapidly pushing work.

Chesapeake & Ohio.—This company is considering the building of a branch from Clifton Forge, Va., southeast to the Hot Springs of Virginia, a distance of about 19 miles.

Western Railway of Florida.—It is stated that this company will extend its line from Sharon to Starke, Fla., and from Sharon to Hawthorne.

Midville, Swainsboro & Red Bluff.—JESSE THOMPSON, of Augusta, Ga., President, writes us as follows.

This road is projected to run from Midville, Ga., via Red Bluff, Summerton, and Modoc to Swainsboro, Ga., a distance of 58 miles. The object of the road is to open up the pine timber lands of Emanuel and Montgomery counties. The right-of-way has all been secured. A portion of the road is already in operation.

Norfolk & Western.—The following is the result of operations of this company for the first four months of 1889 compared with the preceding year:

	1889.	1888.
Gross earnings	$1,662,278	$1,544,422
Expenses	1,099,916	933,853
Net earnings	$562,362	$610,568

Ohio River.—The officers of the Ravenswood, Spencer & Glenville R. R. are: WM. WOODWARD, President; J. A. MCINTOSH, Vice-President; D. W. CHAPMAN, Secretary; C. C. SMITH, Treasurer, and J. G. SHILLING, Attorney.

Richmond & Danville.—Tracklaying on the High Point, Randleman & Ashboro R. R. has been completed to within 3 miles of Ashboro, N. C. The total length of the road is 26 miles.

East & West Alabama.—The Receiver has been authorized to issue $400,000 of Receiver's certificates to raise funds for changing the road to standard gauge and making other improvements.

Fort Payne & Stevenson.—Allison & Shafer, of Fort Payne, Ala., are reported to have the contract for building this Alabama road.

Louisville & Nashville.—This company has commenced the construction of a new union depot at Louisville, KY. It will be built of pressed brick, three stories high with a tower in the center. The L. & N., and the Pennsylvania companies will occupy it.

Craig Mineral.—W. G. SEARS, of Eagle Rock, Va., sends us the following:

This road has been located for 25 miles and the contract for grading 10 miles let to McCarthy & Ross, who are to begin work June 5. The contract for the masonry has been let to C. Rosazza & Co., and bids are called for to construct 1,500 ft. of trestle. We are ready to let the contract for four spans of iron bridge, and specifications will be sent to all bridge companies desiring to compete. Contracts for grading 10 miles in sections of 1 and 2 miles lengths will be let about June 20. Financial arrangements have been made to complete the line to New Castle, 25 miles, by Jan. 1, 1890.

Cape Fear & Yadkin Valley.—The annual report of this company, just received, shows the following results of operations for the year ending March 31, 1889:

Gross earnings	$347,635.29
Operating expenses	185,237.98
Net earnings	$162,397.31

The total number of miles operated is 244.1. During the year surveys have been made and the contracts let for grading an extension from Fayetteville to Wilmington, N. C. About ⅔ of the grading has been completed and it is expected to have the road in operation by Jan. 1, 1890. Surveys are now in progress for an extension from Mt. Airy to connect with a branch of the Norfolk & Western at the Virginia State line, a distance of 9½ miles.

Louisville & Nashville.—This company has commenced work taking out the heavier curves, strengthening the bridges and otherwise improving the line between Louisville, Ky., and Cincinnati, O.

Georgia Southern & Florida.—Waters & Wright have the contract to grade this road from Palatka, Fla., to Jasper, and have commenced work. Morgan & Reynolds, contractors, are at work on the line from Jasper to Lake City, and it is expected to have the entire line from Palatka to Lake City in operation by Oct. 1.

Projects and Surveys.

Kansas City, Chattanooga & Port Royal.—J. C. WALL, of Wallview, Tenn., Vice President has sent us the following information concerning this enterprise.

This road is to run from Augusta, Ga., via Chattanooga, Tenn., Wallview, Tullahoma, Shelbyville, Columbia and New Madrid to Kansas City, Mo. The surveys will begin about June 15. There will be two tunnels and three large bridges. The principal business will be in the transportation of minerals and agricultural produce. About ¼ of the right-of-way has been obtained. The company was incorporated May 10, 1889. Col. JOSEPH F. SHIPP is President, R. A. BOWIE is Chief Engineer and W. C. SMITH is Secretary; all of Chattanooga, Tenn.

Raymond.—Incorporated in West Virginia to build a line of railway from some point on the Pocataligo river in Putnam county, W. Va., to Spencer, Roane county, a distance of about 40 miles. Among the incorporators are: H. M. SMITH, W. H. GOULD and E. SCHONEBAUM. The principal offices will be at Cincinnati, Ohio.

Rome Belt.—A bill is to be introduced into the Georgia Legislature to incorporate the Belt Line Railway Co. to build a belt line of railway around the city of Rome, Ga. The incorporators are JOHN J. SEAY, and JAS. D. KIRKPATRICK, both of Rome, Ga.

Tampa & West Coast.—A company has been organized in Florida to build a railway from Tampa to a point on the Gulf coast near Sutherland. Among the incorporators are: C. T. TAYLOR, E. R. DAVIS, MORRIS MORRISON and C. F. WALL.

Cumming & Warsaw.—The officers of this Georgia company are: A. T. ABBOTT, of Warsaw, President; L. EDMONSON, of Cumming, Vice-President; GEO. L. BELL, Treasurer, and ANSEL STRICKLAND, Secretary; both of Cumming.

Alabama, Georgia & Florida.—This company has been incorporated in Georgia and Florida, to build a line of railway from Columbus, Ga., to a point in Leon county, Fla. C. G. JORDAN, of Columbus, Ga., is interested.

Athens & Jefferson.—The people of Jefferson, Ga., have granted the right-of-way into the city to this proposed road.

Huntington & Guyandotte River.—A correspondent sends us the following:

The surveys are in progress on this road, which is to run from Huntington up the Guyandotte river, a distance of 14 miles. The route is through a region rich in coal, iron ore, and timber. The right-of-way has all been secured. J. L. CALDWELL is President and J. A. FICKINGER is Chief Engineer; both of Huntington, W. Va.

Montgomery & Sylacauga.—The engineers have finished the location of this road from Montgomery to Coosa, Ala., and are now at work locating a site for the bridge across Hatchett creek, near Coosa. B. DUNHAM, of Montgomery, Ala, is President.

Mobile, Jackson & Kansas City.—A correspondent writes us that the locating survey of this road has been completed from Mobile, Ala., to Brandon, Miss., a distance of 176 miles. The route is along the valley of the Leaf river, and affords very easy grades and curves. Almost the entire line runs through a forest of long-leaf yellow pine. F. A. LULING is President, Capt. T. W. NICOL is Chief Engineer, and M. B. BOND, of Hattiesburg, Miss., is Locating Engineer.

Wilmington, Onslow & East Carolina.—Construction is reported begun on this road, which is to run from Wilmington to Jacksonville, N. C., 48 miles.

Meridian & Tuscahoma.—About $14,000 of stock has been subscribed in aid of this road, which is projected to run from Meridian, Miss., to Tuscahoma, Ala., 45.7 miles. W. H. HARDY, of Meridian, is President.

THE NORTHWEST.—Existing Roads.

Wabash.—At a meeting of the Directors of this company held in New York, May 23, the consolidation of the Toledo & Western; the Detroit & State Line Wabash; the Wabash Eastern, and the Wabash Western railway companies under the above name was approved and confirmed. The reorganized company proposes to issue $34,000,000 of first mortgage bonds, $14,000,000 of second mortgage bonds, and $30,000,000 of debenture bonds.

Northern Pacific & Manitoba.—Work is in rapid progress on the Morris-Brandon branch of this road.

Duluth, South Shore & Atlantic.—General Freight Agent WM. ORR is reported as saying that this company will not build into Duluth this season, but may next season.

Belleville, Centralia & Eastern.—The locating surveys of this line have been completed from Belleville to Mount Vernon, Ill., 67 miles. The contract for constructing the road has been let to Ferguson & Co., of Evansville, Ind. Work will commence soon.

Chicago, Milwaukee & St. Paul.—At the annual meeting of the stockholders of this company recently held, the plan to recall all the outstanding 5, 6 and 7 per cent. bonds, and to issue in their place a long term of 4 per cent. consolidated mortgage bond, was approved. The new directors elected were J. HOOD WRIGHT and SAMUEL SPENCER, both of the firm of Drexel, Morgan & Co., AUGUST BELMONT, Jr., and FREDERICK LAYTON.

Elgin, Joliet & Eastern.—An excursion over this newly opened road in which many prominent railway men participated took place a few days ago. The road is to do a belt line transfer business between the railways entering Chicago from the west and the trunk lines coming in on the east. The company expects to be able to handle 1,500 cars daily. NORMAN WILLIAMS is President.

Chicago, Burlington & Quincy.—It is reported that the Denver, Utah & Pacific R. R. running from Denver to Lyons, Colo., 43½ miles, is being changed to standard gauge. An extension of the line to reach the northern Colorado coal fields is under consideration.

Projects and Surveys.

St. Paul, Glenwood & Northeastern.—Incorporated in Wisconsin to build a line of railway from Glenwood, on the Wisconsin Central R. R., to Ashland, Wis. Among the incorporators are: JOHN E. GLOVER, WM. JOHNSTON, and H. J. BALDWIN.

Belleville & St. Louis.—We have received the following from EDWARD L. THOMAS, of Belleville, Ill.:

The surveys have been completed for this road, which is to run from Belleville, Ill., to East St. Louis, Ill., a distance of 8 miles, and the contracts for construction will be let on June 5. The road runs through a level bottom country affording easy grades and curves. The road will do a general freight and passenger traffic; but its prime object is to open up the large coal fields along the route. It is expected to begin track laying about the last of October and to have the road open for traffic by Dec. 1. The company was incorporated March 22, 1889. JOHN S. HILL, of East St. Louis, is President, and LOUIS GRANER, of Belleville, Ill., is Chief Engineer.

Hermosa, Hill City & Western.—C. J. PATTON, of Hermosa, Dak., Secretary, has furnished us the following information concerning this enterprise:

The road is to run from Hermosa via Red Earth, Hayward, Glendale, and Hill City to the Wyoming line, a dis-

tance of 60 miles, with a branch of 20 miles running from Hill City to Custer. The preliminary survey for the entire line has been completed and a portion of the line has been located. About ¾ mile of grading has been done by the company. The right of way has all been obtained. The line is very favorable and will open up a fine mineral country well adapted to stock raising and agriculture. Negotiations are pending for the sale of bonds to aid in constructing the road. The company was incorporated March 10, 1889. MILTON R. MAXSON is President and ALVIN S. WAY is Secretary, both of Hermosa, Dak.

Port Arthur, Duluth & Western.—It is announced that this road has been purchased by New York capitalists and will be completed. The road was projected to run from Port Arthur, Ont., southwest to the International boundary, a distance of 85 miles, where it would connect with the Duluth & Iron Range R. R. and obtain an entrance into Duluth. The road was subsidized by the Dominion Government to the amount of $3,200 per mile and by the Ontario Legislature to the amount of $3,200. HENRY K. WICKSTEED, of Port Arthur, is Chief Engineer.

THE SOUTHWEST.—Existing Roads.

Kansas City, Wyandotte & Northwestern.—It is stated that this company will commence work at once on the extension from the Nebraska State line to Beatrice, 45 miles.

Denison, Bonham & New Orleans.—It is announced that work will soon be resumed on this road. The road was graded from Denison, Tex., to Bonham, 45 miles, some time ago, but the work was abandoned and nothing has been done since. The road was projected to run from Denison to Mt. Pleasant, 120 miles. S. B. ALLEN, of Bonham, is President.

Marion Belt & Chingawassa Springs.—N. S. WOODS, of Wichita, Kan., who has the contract for building 8 miles of this road, has begun work and expects to have this section completed by Aug. 1. O. C. LESUER, of Marion, Kan., is Chief Engineer.

Red River, Sabine & Western.—A contract has been made by which this company agrees to build a line of railway from Palestine, via New Birmingham to Alexandria, La., and to have trains running within 12 months, on condition that the citizens of New Birmingham subscribe $16,500 in cash in aid of the road. The engineers have already commenced work on the locating surveys.

Projects and Surveys.

New Orleans, Fort Jackson & Grand Isle.—We are indebted to CHAS. S. DWIGHT, 25 Carondelet St., New Orleans, La., Chief Engineer, for the following information:

The preliminary surveys have been made and locating surveys are now in progress for this road. The road will run from Algiers on the west bank of the Mississippi river, opposite New Orleans, via Gretna to Fort Jackson, a distance of 65½ miles. An extension of 20 miles to Grand Isle will eventually be made, but for the present a line of steamers will be operated. The route is through a level country affording easy grades and curves. There will be one single span drawbridge. The principal traffic of the road will be in farm produce and the summer travel to Grand Isle. Nearly all of the right-of-way has been secured, and local aid sufficient to build the road obtained from the people of New Orleans and along the route. The contract for 20 miles has been let to Pierson & Moylan, of New Orleans. The remainder of the road will be built by the company. It is expected that tracklaying will begin about Aug. 1, and 40 miles be open for traffic by Oct. 1. H. C. WARMOTH, of New Orleans, is President.

Abbeville & New Iberia.—A project is being agitated to build a line of railway from Abbeville to New Iberia, La., a distance of about 20 miles.

ROCKY MT. AND PAC.—Existing Roads.

Union Pacific.—Surveyors are at work on a line from Erie, Colo., via Lafayette to Denver, a distance of about 25 miles.—This company has already made 4 surveys over the Sierra Nevada Mts. to northern California. It is not probable, however, that a line will be built for some time yet.

Northern Pacific.—Work has been commenced on the Gallatin-Butte branch of this road. The 700-ft. tunnel at the summit of Homestake Pass will be commenced soon.

National City & Otay.—This California road is to be extended 12 miles to Jamul Valley. The company's headquarters are at National City Cal.

Seattle, Lake Shore & Eastern.—Engineers are at work locating the line from a point about 7 miles north of Missoula, W. T., to which the line is graded, to the British Columbia line, a distance of about 36 miles. Grading will commence as soon as a sufficient length of the line has been located.

Southern Pacific.—The annual report of this company for 1888 shows the following results from operations:

Gross earnings	$46,699,000
Operating expenses	30,780,000
Net earnings	15,919,000

The total number of miles operated was 5,758.

Astoria & South Coast.—This road has been graded from Skipanon, Ore., 10 miles in the direction of Seabright, and tracklaying is now in progress. As soon as tracklaying is completed on this section, work will be commenced on the bridge across Young's river. It will be about 1¼ miles long. It is expected that the road will be completed to Seaside by October. Next year it is proposed to extend the road across the mountains to Salem and McMinnville, Ore. HENRY B. THIELSEN, of Astoria, Ore., is Chief Engineer.

Port Townsend Southern.—Payne Bros., of Port Townsend, the contractors, have about 100 men at work on the first section of this road. Piles and timber are on the ground for 15 miles of the road and the contract for constructing 14 miles more will be let immediately.

Rio Grande Western.—This company recently organized to succeed to all the property and rights of the Denver & Rio Grande Western Ry. Co., is marketing an issue of $5,500,000 of 50 year, first mortgage, 4 per cent. bonds. This is a part of the issue of $16,000,000 to take the place of the old bonds held by the stockholders of the Denver & Rio Grande Western, and to aid in widening the gauge of the main line, relaying it with steel rails and furnishing improved equipment.

Canadian Pacific.—The location of the Mission branch has been completed to the International boundary and contracts will be let immediately. A portion of the line is already under construction.

Spokane Falls & Northern.—Tracklaying has been commenced on this road. The road is projected to run from Spokane Falls to Little Dalles, W. T., 175 miles. D. C. CORBIN, of Spokane Falls, is at the head of the enterprise.

Projects and Surveys.

Salt Lake, Nevada & California.—The Wyoming Salt Lake & California and Salt Lake, Nevada & California railway companies have consolidated under the above name. The officers are: JAMES E. FULTON, President; L. C. KARRICK, Vice-President; THEODORE BROUGH, Secretary, and W. P. NOBLE, Treasurer. The consolidated lines if built would form a continuous line from the eastern boundary line of Utah to Los Angeles, Cal.

Evanston & Salt Lake.—Incorporated in Wyoming to build a railway from Evanston, Wyo., to a connection with the eastern terminus of the Salt Lake, Nevada & California R. R., a distance of 20 miles. Among the incorporators are: JAS. E. FULTON, L. C. KARRICK and others of Salt Lake City.

Portland, Mount Hood & Eastern.—Surveys are reported in progress for this road running from Portland, Ore., to Mount Hood, about 70 miles. R. P. EARHART is President and W. A. BANTZ is General Manager.

Denver, Colorado Canon & Pacific.—The engineers of this company have completed a survey to the mouth of the Grand river, 160 miles. The average grade is about 7 ft. per mile. There will be one bridge and a tunnel about 2,600 ft. long on this division.

La Jara, Pagosa Springs & Western.—Organized in Colorado to build a railway from La Jara to Pagosa Springs with branches from Stunner to Piatora and Summitville Camp. Surveys are being made. The officers are: J. W. SCHIFFER, President, F. G. BLAKE, Secretary, and JAS. A. KELLEY, Treasurer.

Oregon Railway Extension Co.—This company has filed a mortgage to the Farmers' Loan & Trust Co., of New York, covering the following prospective roads: from Alto Station on the Oregon Railway & Navigation Co.'s R. R. to Walla Walla; from Walla Walla to Grange City, and from Portland to Astoria.

Alameda County Terminal.—Incorporated in California to build a line of railway from a point on San Francisco Bay, near Alameda City, east to Park Place, with a branch line to Oakland. Among the incorporators are: J. H. WOODARD, C. C. CLAY, E. HALE and R. B. S. YORK; all of Oakland, Cal. The charter is filed as one of the steps in the reorganization of the Alameda railway company.

FOREIGN.

Santa Fe & Cordova Great Southern.—This company is marketing $2,450,000 of bonds to aid in the construction of a railway in the Argentine Republic from the port of Villa Constitucion via the towns of Melincue and Venado Tuerto to La Carlota, a distance of 187 miles. About 40 miles of this distance has been graded and 4 miles of track laid. The country through which the road is to run is well adapted to stock raising and agriculture. The property of the company is exempt from taxation. The line is to be finished by June 22, 1891. The engineer for the company is EDWARD H. WOODS, 6 Victoria St., London.

Africa.—The surveys have been completed for the railway to run from Matadi, at the head of navigation on the lower Congo, to the village of Ndalo, on the south shore of Stanley Pool, a distance of 264 miles. There will be about 16 miles of heavy work from Matadi. It is stated that construction will be commenced in the fall.

RAPID TRANSIT.

Cable Railways.—***Pittsburg, Pa.***—The Pittsburg & Castle Shannon Ry. Co. has decided to build a line from Bailey Ave., Castle Shannon, 2,300 ft. long. It will have a grade of 13 per cent. and will be operated by a stationary engine and a cable.

Baltimore, Md.—The West End Improvement Association contemplates having a cable road built.

Cincinnati, O.—The Walnut Hill extension of the Mt. Auburn Cable Ry. Co. is to be built. It will be double track.

Kansas City, Mo.—The Grand Avenue Cable Ry. Co. will probably extend its Holmes St. branch.

Dummy Lines.—***Fort Payne, Ala.***—The North Fort Payne Land & Improvement Co. will build a dummy line. President, A. S. LOWENTHAL.

Rome, Ga.—The dummy line between Rome and Subligna will be commenced soon.

Street Railways.—***Salamanca, N. Y.***—A street railway is projected to West Salamanca.

Elizabeth, N. J.—The Elizabeth & Newark Ry. Co. will operate its line with the Connelly gas motor.

Pittsburg, Pa.—The Transverse Street Ry. has been leased by the Pittsburg, Allegheny & Manchester Ry. Co. for 9 years. It will be extended to Allegheny.

Baltimore, Md.—The Baltimore City Passenger Ry. Co. is extending its lines in North Baltimore.

Richmond, Va.—A street railway franchise has been applied for by JOHN C. ROBERTSON, of Baltimore.

Chattanooga, Tenn.—The Cameron Hill & Hotel Park Street Ry. Co. is advertising for bids for building an incline street railway up Cameron hill.

Waycross, Ga.—A street railway company is to be organized by G. W. LOTT and J. S. SHAW.

Atlanta, Ga.—The Fulton County Street Ry. Co. has increased its capital stock to $100,000. Work will be begun soon.

New Orleans, La.—The Public Terminal & Transit Co. is to be organized to build street railways.

Peoria, Ill.—The Central Ry. Co. will operate its line by cables or electricity.

Pueblo, Col.—The Pueblo Tramway Co. has been organized by FRANK M. BROWN, C. G. GUION, and J. S. BETTS. Capital stock, $100,000.

Cheyenne, Wyo.—The Cheyenne Street Ry. Co. has made contracts for new cars and rails and will begin extending its line this month.

Vernon, Tex.—The Vernon Street Ry. Co. has been incorporated. Capital stock, $6,000.

Electric Railways.—***Lowell, Mass.***—The Lowell & Dracut Street Ry. Co. has contracted with the Bentley-Knight Electric Ry. Co., of New York, for the equipment of its line to Willow Dale. The Middlesex Electric Light Co. will furnish the power.

Newport, R. I.—Rails for the new line have been received. Capt. EUGENE GRIFFIN has been elected a director.

Beaver Falls, Pa.—An electric line is projected to Brighton and Beaver. The Westinghouse Electric Co. has offered to build and equip the road at $8,000 per mile.

Pittsburg, Pa.—The Squirrel Hill Ry. Co. estimates the cost of its road as follows: grading and track, $68,000; electric plant and cars, $37,000; extras, $10,000.

Troy, N. Y.—The contract for two 180 H. P. Corliss engines for the Troy & Lansingburg Ry. Co. has been awarded to Kelly & Knowlson.

Berkeley, Va.—A company has been organized to build an electric railway.

Charleston, W. Va.—The Kanawha Electric Light Co. will supply power for operating the electric railway.

Massillon, O.—An electric railway is projected.

Cleveland, O.—The Broadway & Newburg Street Ry. Co., the South Side Street Ry. Co., and others, have applied for power to adopt electric traction.

Ishpeming, Mich.—A franchise has been granted for a line 5 miles long between Ishpeming and Negaunee.

Burlington, Ia.—The Union Street Ry. Co. proposes to adopt the Sprague system of electric traction.

Plattsmouth, Neb.—The contract for the extension of the electric line has been let to T. L. Murphy.

Thomson-Houston Lines.—The Thomson-Houston Electric Co., of Boston, Mass., has recently closed contracts for the following lines: Red Bank & Seabright Ry. Co., Red Bank, N. J., 5 miles, 3 cars; Richmond Street Ry. Co., Richmond, Ind., 4 miles, 6 cars; Citizens' Electric Street Ry. Co., Spokane Falls, W. T., 7½ miles, 6 cars.

CONTRACTING.

Trenching.—The work for the new pipe line at Washington, D. C., bids for which will be opened June 20, by Col. JOHN M. WILSON, U. S. A., at the Washington Aqueduct office, will consist in excavating a trench for 20,000 lin. ft. of 48-in. main, 5,400 lin. ft. of 30-in. main, and 400 lin. ft. of 24-in. main; furnishing and delivering at the aqueduct office 190 tons of lead, 4,000 lbs. of jute yarn, and 8 patent jointers. The quantity of material to be excavated will be about 38,000 cu. yds.

State House.—The following proposals for the completion of the State House have been received by the State House Commissioners, Topeka, Kan.: Smead & Co., iron work and metal on dome, $166,000; Bradbury & Vandyk, copper roof, $22,000; H. Bemist, brick arches, $6,200; James Miller & Bro., copper roof, $21,637; Thomas Allen, copper roof, $25,000; Chicago Fire Proofing Co., fire proofing, $56,000; Martineant Adam, brick arches, $8,200; Mision Bros. & Co., iron work and metal on dome, $139,000; St. Louis Fire Proofing Co., fire proofing, $55,000; Fred Hess, copper work complete, $76,201; White Fireproofing Co., fire proofing, $49,975; Pioneer Fire-

proofing Co., $52,775; Kansas City Bridge & Iron Co., complete, $228,000; A. J. Tullock & Co., complete, $214,780; Geo. H. Evans & Co., $195,000. The contract was awarded to Geo. H. Evans & Co., of Topeka.

Water-Works Material.—The following proposals have been received by T. G. BAYLOR, Chief Engineer of the Charlestown Water Co., Charlestown, W. Va.: 4 and 6-in. pipe: R. D. Wood & Co., Philadelphia, Pa., $27.40 and $26 45 per net ton; Donaldson Iron Co., Philadelphia, $28.50 per gross ton. Hydrants and gates: Union Hydraulic Works, Philadelphia, and R. D. Wood & Co. Stand-pipe, 120 ft. high and 15 ins. diameter: Tippet & Wood, Phillipsburg, N. J., $45; Porter Mfg. Co., Syracuse, N. Y., $46.39; Deane Steam Pump Co., Philadelphia, $50; Denithorne & Son, Phoenixville, Pa., $61.79. Duplex water-power pump of 200-gall. capacity per minute; Donaldson Iron Co., Philadelphia, $480; Jonas Barratt Supply Co., Chicago, $900.

Lighthouses.—Sooysmith & Co., of New York, have the contracts for erecting the lighthouses at Crabtree point and Lubec Narrows, Maine.

Sewers.—*Albany, N. Y.*—The Contract Board has awarded the contract for a vitrified pipe drain in Allen St. to Thomas F. Gannan, at $1,077.91: 12 and 6-in. pipe, 88 and 35 cts. per ft.; Y branches, $2.50 each; manholes, $55; jamp-holes, $10.——The contract for a brick sewer in Allen St. was let to Jacob Holler, at $3,650.68: $3.93 per ft. for 48-in. brick, 91 cts. per ft. for 12-in. pipe, $2.87 each Y branch, $58 each manhole, 21 cts. per cu. yd. for excavating.

Pittsburg, Pa.—Estimates of the cost of new sewers, made by the Chief of the Department of Public Works, give $1.35 per ft. for 15-in. pipe, $50 and $60 each for drops, $30 each for manholes, $1.68 per 100 lb. for castings.

Columbus, O.—The following bids have been received for trunk sewers: Franklin Park, N. B. Abbott and Thomas Connell, $49,607.90, H. C. Babbitt, $49,355.82, Donaldson & Walcutt, $46,621.62, John S. Lynch, $44,351.76, D. E. Sullivan, $43,736.22, A. G. Pugh, $41,993.28, W. R. Mercer, $40,708.35, James Westwater, $40,752.50, George H. Kannamacher $38,478.75, B. W. Rees and E. M. Stanley, $38,373.40, F. Fornoff, Sr., $36,812.34. Mr. Fornoff was the lowest bidder. Engineer's estimate, $35,000. Northwest: Donaldson & Walcutt, $72,712.75, James Westwater, $67,530.55, D. Sullivan, $88,032.05, George H. Kannamacher, $61,190.55, N. B. Abbott and Thomas Connell, $81,376.49, H. C. Babbitt, $74,388, A. G. Pugh, $90,438.69, W. R. Mercer, $68,850 85, Michael Corbett and William Dixon, $72,870.58; F. Fornoff, Sr., $63,584.97. Mr. Kannamacher was the lowest bidder. Engineer's estimate, $85,000.

Parkersburg, W. Va.—Bids for sewers were as follows: John Guest, $2 50 and $2.40 per ft. including excavation; C. H. Turner, 57 and 49 cts., exclusive of excavation.

Reservoir.—The contract for the construction of the Dodge Farm reservoir has been awarded to O'Brien & Clark, of New York, at $334,502.30. The list of bids was given last week.

Street Work.—*Providence, R. I.*—The contract for building West Exchange St. from Cove St. to Atwell Ave. has been awarded to Moulton & Mahone, of Lawrence, Mass.

Washington, D. C.—Myron M. Parker has a contract from a syndicate for $40,000 worth of street work in the suburb of Petworth.

Parkersburg, W. Va.—The bids for street paving were as follows: Con. Kennedy, $1.25 per sq. yd. for common brick on the Charleston plan, $1.09 for common brick on the Wheeling plan and $1.40 for fire brick; Hugo Heidenreicht, $1.39 on the Charleston plan and $1.29 on the Wheeling plan; Lenhart & Guest, $1.40 per yd. on the Charleston plan and $1.15 per yd. on the Wheeling plan, they to furnish the steam roller; Williams & Co., $1.45 for hard brick; John Curry, $1 30 on either plan.

Duluth, Minn.—The Board of Works has awarded to Morrison & Hammel the contracts for work on Jefferson St., at $19,506.75, and on Ohio Ave. at $41,367.

Minneapolis, Minn.—Asphalt paving is proposed for some streets. About a year ago the City Council voted to allow property owners to substitute asphalt for stone where stone pavement had been ordered, but no streets have yet been paved with asphalt.

Sioux City, Ia.—A contract for grading streets has been let to Reeve Bros. & O'Neil at 4¾ cts. per cu. yd. for cut and fill. For grading the cut on the military road the lowest bid was from B. Crowley, 8¼ cts. per cu. yd.

PROPOSALS OPEN.

Brick and Cement.—For sewer; 225,000 hand-made bricks, 375,000 machine-made bricks, 1,500 bbls. American hydraulic cement, 350 bbls. Portland cement, 400 cu. yds. sand, 46,500 paving blocks, 500 cu. yds. of stone, 11,000 ft. B. M. North Carolina pine, 16,300 ft. B. M. Virginia pine. A. E. SMYRK, City Commissioner, Baltimore, Md. June 13

Lighthouse.—Work at lighthouse pier at Oswego, N. Y. Major L. COOPER OVERMAN, U. S. Lighthouse Engineer Office, Cleveland, O. June 14.

Paving Cement.—Curbing, bricks, asphalt tiles, artificial stone tiles, asphalt paving blocks, granite paving blocks, cement and lime. THE DISTRICT COMMISSIONERS, Washington, D. C. June 15.

Poles.—Furnishing 300 chestnut electric light poles, 25 ft. long. THE CITY CLERK, Springfield, Mass. June 15.

Cement.—Furnishing 1,500 casks of first quality Rosendale cement and 800 casks of first quality English Portland cement. THE WATER BOARD, City Hall, Boston, Mass. June 15.

Jail.—Steel cells in new jail. MCCAW & MARTIN, architects, 34 Washington St. THE COUNTY CLERK; Portland, Ore. June 18.

Bridges.—Two 80 ft. span iron bridges one on stone abutments, and one on tubular piers. F. G. O'FLAHERTY, County Surveyor, Kansas City, Mo. June 18.

Dike.—Brush dike. Col. C. P. E. BURGWYNE, U. S. Engineer Office, Richmond, Va. June 20.

Bridges.—A wrought iron 3-truss bridge over the Miami & Erie Canal at Browne St., 81 ft. span, 2 roadways of 14 ft. and 2 footways of 8 ft. each. Plans and specifications with the engineer. THOS. G. SMITH, President, Board of Public Affairs, Cincinnati, O. June 21.

Road Work.—Improving county roads. THE COUNTY COMMISSIONERS, Cincinnati, O. June 22.

Pipe and Valves.—Cast-iron water pipe and valves. THE DISTRICT COMMISSIONERS, Washington, D. C. June 22.

Bridge.—Over the Olentangy river at Dodridge St.; sandstone on iron pile substructure; iron superstructure with 1 span of 90 ft. and 1 of 105 ft., Dick plan. Plans and specifications on file. F. J. REINHARD, County Auditor Columbus, O. June 26.

Street Work.—Grading and improving. W. P. RICE, City Engineer, Cleveland, O. June 27.

MANUFACTURING AND TECHNICAL.

Locomotives.—The Baldwin Locomotive Works, of Philadelphia, Pa., have an order for 15 freight engines for the Missouri, Kansas & Texas.——Two dummy engines have been sent to Spokane Falls, W. T.

The Cooke Locomotive Works, of Paterson, N. J., have eliverd 6 passenger engines, with cylinders 19 x 24 ins., to the Newport News & Mississippi Valley.

The Brooks Locomotive Works, of Dunkirk, N. Y., are building 3 mogul engines for the Lake Erie & Western.

The Baker Iron Works, of Los Angeles, Cal., are building a 15-ton engine for the Los Angeles & Santa Monica.

The Old Colony road is building 4 engines at its shops at South Boston, Mass.

The Texas Pacific road has ordered 25 locomotives.

Cars.—The Wason Car Co., of Brightwood, Mass., has completed 10 passenger cars for the Provincial Railways of Buenos Ayres: they are 52 ft. long and 9 ft. 10 ins. wide.——Five combination baggage and smoking cars for the Flint & Pere Marquette, and 5 open excursion cars for the Brookiyn, Bath & West End, have been turned out.

The South Baltimore Car Co., of Baltimore, Md., is building 750 freight cars for the Richmond & Danville, and 50 for the West Virginia Central.

Osgood, Bradley & Co., of Worcester, Mass., have completed a car for the Bangor & Piscataquis and another for the Knox & Lincoln.

J. M. Jones & Sons, of West Troy, N. Y., have sent 4 open street railway cars to Springfield, Mass.

The Russell Wheel & Foundry Co., of Detroit, Mich., has sold 4 logging cars to the Hamilton Railway & Lumber Co., of Hamilton, N. C.

Railway Supplies.—Roberts Bros., of Robertsville, La., want 2 miles of 30-lb. steel rails.

A. B. Coe, M. E., of Chattanooga, Tenn., wants 6½ miles of 20 or 30-lb second-hand iron or steel rails.

Flowers & Peagler, of Forest, Ala., want rails and rolling stock for a narrow-gauge line, 5 miles long.

C. C. Mengel, Jr., & Co., of Louisville, Ky., want material for a logging road and a pole railway.

Well Machinery.—J. P. Benham, Schooner Point, Ind., wants plant for sinking wells for gas, oil and water.

The Berlin Iron Bridge Co., of East Berlin, Conn., has a contract for an iron and glass building at Winsted, Conn., for the Franklin Moore Bolt Co.

Rail Joints.—The Morgan Rail Joint Co. has been incorporated at Troy, N. Y., by JOHN MCKENZIE, MORRIS J. MCKENZIE, ROBERT BLACK, H. A. COX, and JOSEPH PEABODY. Capital stock, $100,000.

Rails.—The Chicago, Kansas & Nebraska Ry. Co. will give out a large order for steel rails for the Oklahoma extension.

The Louisiana & Texas Construction Co. has been incorporated at New Orleans, La., by E. H. TAYLOR, W. F. LAKE, and M. C. HURLEY. Capital stock, $100,000.

The American Water-Works & Guarantee Co., of Pittsburg, Pa., held its annual meeting at McKeesport, Pa., May 20, and elected the following officers to serve for the next year: Chairman, D. W. HITCHCOCK, of Boston; Vice-Chairman, E. C. CONVERSE, of New York; Secretary and Treasurer, JAS. S. KUHN, of McKeesport; General Manager, WILL S. KUHN, of Pittsburg. Directors: JOHN H. FLAGLER and E. C. CONVERSE, of New York; D. J. GARMAND and W. S. KUHN, of Pittsburg; D. W. HITCHCOCK, JAMES S. KUHN, and C. H. PAYSON, of Portland, Me.

The Roanoke Rolling Mills, of Roanoke, Va., have a contract for 200 tons of bar iron for the Baldwin Locomotive Works, Philadelphia.

Switch Cabin.—The Connecticut River Ry. Co. has put up a switch tower or cabin at the junction at Chicopee, Mass., and all the gates, switches, and signals at the grade crossings will be operated from this tower.

Road Rollers.—The Street Committee of Bristol, R. I., has purchased a 15-ton Aveling & Porter steam road roller from W. M. HAWES, of Fall River, Mass.

Sewer Pipe.—The Trustees of Seattle, W. T., will not put in a plant for the manufacture of the "Oriel" sewer pipe for the new sewerage system as proposed.

Stone Crusher.—The Highway Commissioners, Westerly, R. I., have received a rock crusher from the Gates Iron Works, Chicago.

Oil Pipe Line.—The new 8-in. pipe line now being laid at Grove City will extend from Parker to Signet, Wood Co., O., and will connect at that point with the Lima line and thence run to Chicago.

Philadelphia & Reading Rolling Stock.—The Philadelphia & Reading Railroad Co. is making extensive improvements in its rolling stock. It is receiving, on an average, about 15 freight and coal cars per day, and in a short time the quota of rolling stock will be completed. Besides receiving new cars, the old ones are being repaired and placed in first-class condition. When the company passed into control of the present management, the rolling stock had materially depreciated, and Mr. CORBIN created a new car trust loan, and ordered a number of new cars from the Wilmington car shops. Up to the present time there have been 1,821 cars turned over to the company; these are so constructed that they can be used either for coal or freight. They can be transformed into lumber cars at a moment's notice, and larger and higher loads can be placed on them. The company has also ordered 50 Wickes' patent refrigerator cars, to be used principally in the carrying of beer. A number of twin hopper-bottom gondola cars have been ordered, and will soon be completed. The company has increased its equipment to handle the anticipated coal output by an addition of 1,200 20-ton cars and 60 locomotives. It is estimated that the new equipment will increase the carrying capacity of the road by 200,000 tons a month.

The Root Boiler.—The use of the Root safety water-tube boiler, manufactured by the Abendroth & Root Mfg. Co., New York, is in use from the Atlantic to the Pacific. The safety assured by the use of this boiler for all steam generating purposes is an important consideration, and not the least of its attendant advantages is the heavy percentage of insurance saved. The California hotel and theatre at San Francisco, one of the most notable structures on the Pacific coast, is supplied with 2 Root boilers, 225 H. P., which will furnish power for the electric lights with which the edifice will be lighted throughout, as well as for running the elevators. They will also be used for heating purposes. Mr. J. M. WOOD, of Chicago, was the architect, and Geo. H. Tay & Co., of San Francisco, were the contractors.

Railroad Equipment.—The firms of Perkins & Mott and Thomas B. Inness & Co. have consolidated, and are now known as Thos. B. Inness & Co., located at 115 Broadway, New York.

The Bucyrus Foundry & Mfg. Co., of Bucyrus, O., has removed its Chicago office from 115 Dearborn St. to Room 656 in the "Rookery," corner of La Salle and Adams Sts. This office is under the management of Mr. E. W. CRAMER, who represents both this company and the Bucyrus Steam Shovel & Dredge Co., in Chicago and vicinity.

The Reliance Gauge Co., of Cleveland, O., a little more than a year ago leased a 3-story block in which to manufacture its safety water columns; it was expected that this would be sufficient for the business for at least 5 years, but the business has grown so much that already the company is putting up an addition to the block.

The Addyston Pipe & Steel Co. had a small fire at its works at Addyston, O., May 29; it consisted only of the burning of the roof of the company's gas works, entailing but slight loss and causing but little delay in manufacture.

The Hersey Meter Co., of Boston, reports business improving very fast; excellent reports have been received from cities which have given this meter several years trial. It is difficult now for a water meter company to work up a swindle on a city, and the Hersey Meter Co. has had to run 500,000 cu. ft. through a ⅝-in meter in some cities as a test.

The C. D. Wainright Co. has been organized to manufacture improved corrugated tubing, also all descriptions of heaters. The office is at 73 Oliver St., Boston, Mass.

The Contractors' Mfg. Co., of Buffalo, N. Y., has recently shipped to the city of Mexico 10 hoisting machines for mining purposes, 10 large ore buckets and 5,000 ft. of ⅝-in wire rope.

Pipe Joint.—ISAAC B. POTTS, of Columbus, O., has invented a pipe joint and fittings of a novel character, by which connections can be made with iron pipes without threads on the pipe, the use of solder or caulking. It is a device for general use in water, gas and

steam systems without the expense of skilled labor but effectual in its operation.

Notice of Removal.—The Prentiss Tool & Supply Co. have removed from No. 42 Dey St., to No. 115 Liberty St.

BRIDGES AND CANALS.

Bridge Notes.—*Holyoke, Mass.*—The contracts for the new canal bridge at Dwight St, and removing the old bridge to Cabot St. have been awarded by the Highway Committee to the Berlin Iron Bridge Co., of East Berlin, Conn., at $14,880 and $900.

Brooklyn, N. Y.—Proposals for the new bridge, pier, and approaches at Grand St., over Newtown creek, will be received by the Bridge Committee, at the County Court-House, until June 12.

Lockport, N. Y.—The contract for the abutments of a bridge over Tonawanda creek, about 400 cu. yds. broken ashlar masonry, has been awarded by JULIUS FREHSEE, Surveyor, to Patrick H. Tuohey, at $3,435. The contract for the superstructure, 155 ft. span, was let to the Wrought Iron Bridge Co., of Canton, O., at $3,000.

Philadelphia, Pa.—The Philadelphia & Reading Ry. Co. has been granted permission by the Park Commissioners to build a bridge 100 yds. south of the present stone bridge at the Falls. The drives on the east side of the river are to be spanned by a stone arch, and on the west side appliances are to be used for deadening the sound of the traffic. The bridge will be used by the Baltimore & Ohio.

Lancaster, Pa.—The Pennsylvania Railroad is now engaged in putting up a temporary scaffolding at Mill creek to provide for the removal of the iron bridge there to make room for a stone structure. The iron bridge will be removed about July 1.

Baltimore, Md.—The mayor has signed the bill appropriating $80,000 for a new iron draw at the Light St. bridge.

Richmond, Va.—The free bridge across the Jame river will probably be replaced by a new iron structure at a cost of about $50,000.

Milledgeville, Ga.—The contract for an iron bridge over the Oconee river was let June 3 to Geo. H. Crafts, of Atlanta, Ga., at $11,660.

Parkersburg, W. Va.—The proposition to issue $80,000 in bonds for a bridge over the Little Kanawha river has been defeated by public vote.

Wheeling, W. Va.—The Wheeling Bridge Co. has been organized. President, Capt. JOHN MCLURE; Vice-President, H. SCHMULBACH; Secretary, J. E. HUGHES.

Birmingham, Ala.—It is proposed to build a bridge over the railway at 21st St.

Memphis, Tenn.—The contract for granite for the piers of the Mississippi bridge of the Memphis & Kansas City Bridge Co. has been let to the Southern Granite Co., of Atlanta, Ga., at about $100,000.

Nicholasville, Ky.—Mr. J. H. PEARSON, Chief Engineer of the Richmond, Nicholasville, Irvine & Beattyville Ry., has awarded the contract for the Kentucky river bridge, 300 ft. channel span, to the Shiffler Bridge Co., of Pittsburg, Pa. The same company has contracts for 3 other bridges for the same road.

Taylorstown, O.—Proposals for an iron bridge over the Baltimore & Ohio will be received until June 26 by F. J. REINHARD, County Auditor, Columbus, O. One span, 100 ft. long, 16 ft. roadway; capacity, 60 lbs. per sq. ft. of floor. Plans and specifications on file.

Delaware, O.—The County Commissioners received proposals from 15 different establishments for the construction of a bridge over Big Walnut creek at Galena. The prices ranged from $11.80 to $14.95 per ft., the Champion Bridge Co. being the highest and the Milwaukee Bridge Co. the lowest.

Logansport, Ind.—The contract for the erection of 2 wrought-iron truss bridges has been awarded by the Commissioners of Cass County to the King Iron Bridge & Mfg. Co., of Cleveland, O., at $10,736 and $17,948.

Belleville, Mich.—It has been voted to issue bonds to build a bridge over the Huron river.

Houghton, Mich.—An iron approach to a bridge is to be built; 410 ft. long, 16 ft. roadway, 8 ft. sidewalk; cedar block paving. Address GEO. C. SHELDEN.

Holland, Mich.—The contract for the new iron bridge across the Black river has been awarded to the Wisconsin Bridge Co., of Milwaukee, Wis., at $4,000.

Minneapolis, Minn.—The City Engineer is preparing plans for bridges at the railway crossings at Laurel, Fort, and 15th Aves.

Topeka, Kan.—The Bridge Committee has recommended the construction of a wagon bridge, 36 ft. wide, with a 36 ft. roadway. Cedar block paving. Plans are being prepared and bonds for $225,000 are to be issued.

Wellborn, Tex.—The County Commissioners have decided to build 2 bridges over the Brazos river, one of which will probably be at Wellborn.

Hempstead, Tex.—It is proposed to build a free bridge over the Brazos river, between Hempstead and Belleville.

Mission, B. C.—The contract for the Fraser river bridge for the Canadian Pacific Ry. has been let to J. McGillivray.

Canals.—The Orange Transit Canal Co., of Floral City Fla., is having surveys made for an extension of 20 miles of its canal.

The Middlesborough canal, at Middlesborough, Ky., for which S. P. CONDON has the contract, will cost about $30,000.

Bridges and Culverts.—Contracts have been awarded as follows by F. J. O'FLAHERTY, County Surveyor, Kansas City, Mo.: 1 iron truss bridge, Wrought Iron Bridge Co., $587; abutments for same, I. Walsh, $3.95 per cu. yd.; 4 wooden bridges, John Dwyer, $90 each; 3 wooden bridges with trestles, John H. Sparks, $236 each; 1 arched culvert, John Burk, $4 per cu. yd.; 3 box culverts, John Burk, $7.15 per cu. yd.; 4 stone abutments, Chas. O'Connor, $2.80 per cu. yd.

ELECTRICAL.

Electric Light.—*Rockland, Me.* The Eastern Construction Co. has offered to put in an electric light plant for $7,000.

Hartford, Conn.—The contract with the Hartford Electric Light Co. expired June 1; the only bid for the ensuing year was from this company, and this will not be acted upon by the Council before June 10. The acceptance of the bid is recommended.

Greenbush, N. Y.—A resolution to accept the bid of the Greenbush Electric Light Co., for lighting the village by electricity was lost by a tie vote. A resolution for receiving proposals for electric lighting was adopted. The bids will be opened at the next meeting.

Tonawanda, N. Y.—The Tonawanda Electric Light and Power Co., has been incorporated by J. N. HINKEY, A. G. KENT and A. C. CAMPBELL. Capital stock, $1,000.

Lansingburg, N. Y.—Bids of lighting the streets with 100 arc lights of 2,000 c. p., have been received.

Newark, N. Y.—A contract has been made with Moffett Hodgkins & Clarke, of Watertown. There are to be 40 arc lights of 2,000 c. p., to burn 26 nights per month. The rental is $2,400 per year for 5 years.

Marietta, Pa.—A local company, with $10,000 capital stock, has been organized.

Allegheny, Pa.—The Allegheny County Light Co. and the East End Electric Light Co. want to put in arc instead of incandescent lights on the side streets. The contracts were made in December last and are for 3 years from January 1, 1889. The lights are to be in operation by July. The price of the arc lamps is $100 per annum, candle power incandescent, $12 per annum, and 25 candle power, $16.

Baltimore, Md.—The Mayor has signed the ordinance directing the contract for lighting to be made for one year with the lowest responsible bidder. The Brush Co., will probably continue lighting.

Bainbridge, Ga.—An electric light system is contemplated.

Tiffin, O.—The city has contracted to pay $88 each per year, for electric lights of 2,000 c. p.

Bryan, O.—The city is now lighted with 38 arc lights on the Schuyler system.

Springfield, Ill.—The Springfield Electric Light & Power Co. has located its 100 new lights.

Lakeside Minn.—The Lakeside Electric Light & Power Co., has been incorporated by EDGAR BROWN, J. E. MARVIN and W. VAN BRUNT.

Sauk Centre, Minn.—The Council has passed an ordinance permitting the Acme Electric Co. to put in a plant for furnishing light, heat and power. The city will use 10 arc lights of 2,000 each for the business portion of the city, and numerous incandescent lights for the outskirts. The company will also furnish power for running machinery.

Brainerd, Minn.—The city has voted in favor of giving a contract of electric lighting to a company which proposes to develop the water power.

Argentine, Kan.—The Argentine Electric Light Co., has been organized by T. J. ENRIGHT, A. KLEIN and J. P. BYRNE. Capital stock, $150,000.

Hutchinson, Kan.—A franchise for electric lighting for 25 years has been granted to R. R. PRICE.

Houston, Tex.—The city's contract with the Houston Electric Light and Power Co. expired May 31, and the company was notified to cease lighting.

St. Mary's, Ont.—Two bids were received for electric lighting; the Ball Co., of Toronto, bid 12½ cts. per night per arc light of 1,000 c. p., and 5 cts. for 30 c. p. incandescent lights; the Reliance Co., of Waterford, bid 13 cts. and 7 cts.

Electric Light Wires.—At Cincinnati, O., the Board of Public Affairs has adopted a resolution rescinding all permits granted to electric light companies for stringing wires, and the engineer was instructed to allow no more wires to be strung until samples have been submitted to the Board for examination. This action was taken at the recommendation of Prof. FRENCH.

WATER AND MUNICIPAL.

Water Power.—*Winnipeg, Minn.*—The Water Power Committee has requested Mr. J. T. FANNING, of Minneapolis, Minn., to make an examination and report upon the proposition to utilize the water power of the Assiniboine river. The clerk has also been instructed to write to mill owners and others employing machinery, inviting them to meet the committee and give evidence as to their requirements, the present cost to them of steam per horse power, and the inducements which would lead them to take advantage of the water power if rendered available by means of the expenditure proposed on the part of the city.

Sewerage.—*Waterville, Me.*—Work on the sewerage system has been commenced, under the charge of Superintendent FAIRBANKS.

Fairfield, Me.—Surveys for a sewerage system have been made by Mr. GETCHELL, C. E., of Vassalboro.

Ware, Mass.—It is proposed to appropriate $12,000 for a part of the new sewerage system to be built this summer.

Westfield, Mass.—Work will be commenced in June on the sewers for which $25,000 has been appropriated.

Providence, R. I.—The Board of Aldermen has adopted resolutions creating a Sewer Commission to direct the construction of a sewerage system in accordance with Mr. GRAY'S plans, which were endorsed by a committee of the American Society of Civil Engineers in 1887, and adopted by the City Council.

Albion, N. Y.—Mr. GASKILL, of Medina, has made a proposition to put in sewers, with an outfall into Marsh creek. The cost is estimated at $25,000.

Passaic, N. Y.—The Newark Aqueduct Board has applied for an injunction to restrain the city of Passaic from building sewers to discharge into the Passaic river.

Circleville, O.—The proposition to expend $40,000 on a trunk sewer has been defeated.

Norfolk, Va.—The City Council has authorized the issue of bonds for building sewers in District D.

Chattanooga, Tenn.—The contract for completing the Broad St. sewer has been let to GEO. L. GILLESPIE at $10,709.

Meridian, Miss.—A system of sewers is projected.

Three Rivers, Mich.—The question of establishing a sewerage system is being agitated.

Winnetka, Ill.—Sewers are to be built shortly.

Madison, Wis.—An order has been passed authorizing the construction of certain sewers in accordance with the plans for the several systems of sewerage.

Winona, Minn.—The Sewerage Committee has reported in favor of adopting the Shone system.

Sioux Falls, Dak.—About 8 miles of sewers are to be built this year.

Grand Island, Neb.—The city has voted to issue bonds for $50,000 for a system of sewerage.

Los Angeles, Cal.—The Council has passed an ordinance which designates the route of the outfall sewer, and is preparatory to the starting of the work.

Waco, Tex.—The Council has authorized the issue of $35,000 in bonds for a sewerage system.

Hyatt Filters.—The Hyatt Pure Water Co., of New York, has recently closed contracts to put in its system of filtration at Shreveport, La., and Stephen's Point, Wis. The new plants put in at Richfield Springs, N. Y., and Asheville, N. C., have been put in operation.

Sewer Flushing.—The Fort Smith Water Co., Fort Smith, Ark., is said to refuse the use of water for sewer flushing purposes, although such use is specified in the franchise given the company. The city has offered the company $4,500 per year for 100 additional hydrants, which the company has refused. The proposition will probably not be renewed. Pending these differences the new sewer system just about completed cannot be used.

Water-Works.—*Maine.*—Caribou. Work on the dam and water-works is progressing.——Presque Isle. About 1,000 ft. of pipe extensions will be used.

New Hampshire.—Milford. Work is to be commenced very soon.

Massachusetts.—Foxboro. The town has voted to contract with the water supply district for a water supply at a cost of $30 a hydrant, on a basis of not less than 50 hydrants, for the term of 5 years. The district has appointed a committee to see if the Legislature would authorize them to issue bonds to the amount of $75,000 for the purpose of introducing a system of water-works.

Connecticut.—West Haven. The quality of the water supply is said to be unsatisfactory.——New London. A new high-service system is contemplated.

New York.—Green Island. There has been some difficulty between the village trustees and the water company in regard to the consumption, and it is proposed to put in meters.——Potsdam. About ¾ mile of main is to be laid.——Avoca. The new works will probably be finished in July.——Castile. The new iron tank has been completed.——New Rochelle. The water company is extending its mains to Premium Point.——Newburg. The Water Commissioners are in favor of a system of filtration——Le Roy. There are no public water-works, only Holly pumps for use in case of fire in the business part of the town. Water-works are projected.

Pennsylvania.—Bloomsburg. A new pump has been put in; 5 to 10 hydrants and 2 to 6 meters are to be placed and a new reservoir built.——Allegheny. The Water Committee will lay about 15 miles of 6, 8 and 10-in. pipe, contracts for pipe laying have been let to James McAfee and T. M. Scanlon.

District of Columbia.—Washington. The District Commissioners will receive bids until June 22 for cast-iron pipe and valves.

Virginia.— Roanoke. A Philadelphia syndicate has purchased the franchise and plant of the Ronake Water-Works & Gas Light Co.——Covington. The contract for the water-works has been awarded to Thomas Barry & Co., of Richmond. There will be a reservoir of 47,000 galls. capacity.

Georgia.— Macon. The Macon Water & Gas Co. will not put in its new pump yet. Northern capitalists are said to be negotiating for a site for new works.

Alabama.—Florence. The water mains are being extended about 3 miles.——Fort Payne. The new works will be on the stand-pipe system.——Spring Garden. The Spring Garden Water Co. wants 1,400 ft. of 3-in. cast-iron pipe and 1,700 ft. of 2-in. wrought-iron pipe.——Birmingham. It is proposed to purchase land and several artesian wells at Gate City and to pipe the water to Birmingham.

Louisiana.—New Orleans. The city has accepted the decision of the Supreme Court of Louisiana in favor of the water company.

Tennessee.—Nashville. The superintendent is preparing specifications for a new engine of 10,000,000 or 15,000,000 galls. daily capacity. The 50,000,000 galls. reservoir will be completed by November. Bids will shortly be advertised for 36-in. pipe.——Laurenceburg. A water company is to be organized.

Kentucky.—Danville. The cost of the projected works is estimated at $80,000.——Central City. The Central City Water Co. wants pumps, hydrants and 8-in. pipe.——Middleborough. Water-works are to be built by J. H. MEAD, of New York.

Ohio.—Cleveland. About 10½ miles of pipe extensions are to be laid by the water trustees. Work is progressing on the tunnel.——Cincinnati. The water-works at the Spring Grove Cemetery have been completed. They cost about $25,000.——Marietta. Mr. JOHN W. HILL, C. E. of Cincinnati, has been engaged by the City Council to prepare plans and specifications for water-works.

Indiana.—Indianapolis. The Indianapolis Water Co. will enlarge and extend its works, build a new pumping station and spend $150,000 for new plant.

Michigan.—Gladstone. Proposals for furnishing and laying 700 ft. of 16-in. cast-iron pipe will be received by A. P. SMITH, City Clerk, until June 15.——St. John's. Proposals for the construction of water-works will be received until June 12 by C. P. BAKER, Village Clerk.——Monroe. The Monroe Water Co. will open proposals June 10 for building engine house and inlet crib in Lake Erie; also for laying 2,500 ft. of 20-in. cast-iron inlet pipe, 22,680 ft. of 12-in., 4,100 ft. of 10-in., 16,980 ft. of 8-in., 20,946 ft. of 6-in., 4,550 ft. of 4-in pipe; also 128 hydrants and 77 valves. Mr E. F. FULLER, of 11 Wall St., New York City is the engineer.

Wisconsin.—De Pere. The De Pere Artesian Water Supply Co. has increased its capital stock from $5,000 to $10,000.

Iowa.—Algona. Water-works are to be built.——Cedar Falls. Proposals will be opened by the Water Committee on June 10 for furnishing and laying about 2,972 ft. of 4-in. cast-iron pipe, and other work for extensions.

Minnesota.—Lakeside. The Lakeside Water & Light Co. has been incorporated by EDGAR BROWN, J. W. MARVIN, and E. E. SHERWOOD. Capital stock, $50,000.

Kansas.—Argentine. Plans for the water-works are being prepared by Nier & Mitchell, of Kansas City, Mo. The cost of the plant will be about $75,000.

Nebraska.—Madison. A pump and boiler for the water-works has been received from the Pond Engineering Co., of St. Louis.——Minden. Water-works will probably be built this summer.——Crete. The city has contracted for works to cost $60,000.——Lincoln. The new well and pumping machinery will soon be in operation; the well will yield about 1,500,000 galls. per day.

Dakota.—Waspeton. During this season there will be about 3 to 5 miles of pipe laid; also 12 hydrants, 15 valves, and 5 meters set.

Montana.—Helena. City Engineer MILLER is engaged in investigating the sources of water supply, and will report shortly.

Colorado.—Greeley. The works will be in operation in July. —— Central City. The entire issue of $30,000 water bonds was sold May 25 to W. J. Hayes & Son, of Cleveland, O., at $32,850.——Pueblo. The Water-Works Trustees have purchased from the Holly Mfg. Co., of Lockport, N. Y., 2 Gaskill, horizontal compound engines of 5,500,000 galls. daily capacity each, to increase the water supply on the North Side. The plant will cost $55,000 complete.——Aspen. About 5,000 ft. of 4 and 6-in. pipe will be laid, and 6 hydrants and 8 valves set.

Washington Territory.—Cheney. Water-works are now under construction.

California.—Phœnix. The new stand-pipe has been finished.——Merced. The main pipe from Huffman's dam, which supplies the town with water, burst a few weeks ago, and the town was without water for several hours.——San Diego. The city engineer has been directed to prepare plans and estimates for a system of water-works.——Red Bluff. About 4,000 ft. of 3 to 8-in. pipe are to be laid.

Utah.—Park City. A small amount of mains are now being laid.

Idaho.—Boise City. The question of an improved water supply is being agitated.

Special Reports of Water-Works Construction.

Caribou, Me.—H. M. HEATH, Augusta, Me., Treasurer of the Caribou Water Co., gives the following information:

Construction was begun May 10 and the works are to be in operation Oct. 1. M. M. TIDD, of Boston, is engineer, and FREELAND JONES, of Caribou, is assistant engineer. The company will put in its masonry and erect its buildings. Contracts for pumping machinery have not been awarded, but contractors for other material and work are: For pipe, R. D. Wood & Co., Philadelphia; for specials, Builders' Iron Foundry, Providence, R. I.; trenching and pipe laying, Dan'l Dacy, Boston; stand-pipe, E. Hodge & Co., Boston; Matthew's hydrants and Eddy valves will be used. The supply will be pumped from Aroostook river to a stand-pipe. The pump will have a daily capacity of 1,000,000 galls., and will be driven by water power; the stand-pipe will have a capacity of 155,000 galls. There will be 3¼ miles of 8 and 6 in. cast-iron and wrought-iron mains and 26 hydrants. The capital stock of the company is $60,000 and there are $80,000 of bonds. The franchise provides for freedom from taxation and a yearly rental of $80 each for 25 hydrants. A dam is being built across the Aroostook river, and the company will have a surpuls of 1,200 H. P. to lease. Population, 4,000. A. B. FISHER will be Superintendent.

Fort Fairfield, Me.—The following information has been given by E. H. GOWING:

The Frontier Water Co. was chartered in March, and has contracted with W. H. WHITCOMB, Norway, Me., to construct a system of water-works, consisting of a 1,000,000-gall. reservoir, 13,000 ft. of 10, 1,000 ft., of 6, and about 3,000 ft. of 4-in. pipe. There will be 17 hydrants. It is expected that work will be begun about July 1. Estimated cost, $40,000. President, NICHOLAS FESSENDEN; Secretary, E. L. HOUGHTON; Treasurer, J. F. HACKER. The company's charter includes electric lighting, but as yet nothing has been done about constructing an electric light plant.

Torrington, Conn.—C. L. MCNEIL, Secretary, informs us that the company is thinking of putting in a new reservoir.

Baldwinsville, N. Y.—The town recently voted to raise money by taxation for water-works. Address Town President BLANCHARD for further information.

Potsdam, N. Y.—W. F. P. SEALY, Superintendent, informs us that an auxiliary steam pump, to cost about $1,000, is contemplated; also that the mains will be extended ¼ mile.

Goldsboro, N. C.—The following was given by E. F. FULLER, 11 Wall St., New York:

The Goldsboro Water Co will have the works now under construction in operation by Aug. 1. E. F. FULLER is designing, and JNO. W. NELSON, Constructing Engineer. The officers are: President, CHAS. M. BERRIATT; Secretary, NATHANIEL P. HOBART; Treasurer, R. I. SHANNON. The Worthington Steam Pump Co. furnish the two 1,000,000-gall. compound, condensing pumps, and Dewey Bros., Goldsboro, the boilers. There will be a stand-pipe 18 ft. in diameter by 110 ft. high, from Tippett & Wood Phillipsburg, N. J. Ludlow valves and hydrants will be used. Water is taken from Little river. There will be 7¼ miles of mains and 54 hydrants. The works will cost $100,000, and there will be $100,000 of capital stock and $75,000 of bonds. The franchise is for 30 years. Population, 6,000.

Spring Valley, Ala.—J. W. TUCKER, President of the Spring Garden Water-Works, Land & Improvement Co., writes that his company proposes to have in operation by Aug. 15 water-works to supply the village of 400 inhabitants. Water will be pumped from a large spring to a reservoir. Estimated cost, $1,500.

Brenham, Tex.—J. N. BROWN, Secretary, informs us that two miles of new mains have been proposed for this summer.

Natchez, Miss.—The following was given by J. F. THOMPSON, Elmira, N. Y., President of the Natchez Water & Sewer Co.:

Works will be completed in August, construction having been begun in April, with J. JONES as Designing, and P. K. YATES, Natchez, Constructing Engineer. In addition to the water-works the company is building 7¾ miles of sewers. The contractors are: For masonry, —— Culberston, Pine Bluff, Ark.; sewers, Irwin & Maher, Greenville, O.; N. O. Nelson Mfg. Co., St. Louis, Mo.; boilers, Mid Continental Boiler Works, Kansas City, Mo.; pipe and specials, South St. Louis Foundry; trenching and pipe-laying, HENRY DIEDRICH, Natchez; stand-pipe, FRANK E. PALMER, Kansas City, Mo. White hydrants and Eddy valves will be used. Water will be pumped from the Mississippi river to a stand-pipe 12 ft. in diameter by 150 ft. high. There will be a 1,500,000-gall. compound and a 1,000,000-gall. high-pressure pump; also 8 miles of 14 to 6-in. cast-iron mains, and 115 hydrants. The cost of water-works and sewerage combined will be $160,000. The franchise is for 30 years, and the annual hydrant rental is $50 each. Population, 12,000.

Harrodsburg, Ky.—E. H. GAUTIER has given the following:

The Harrodsburg Water Co. will begin the construction of water-works the latter part of July, and the works will cost $50,000. Water will be pumped from Salt river, or wells, to a stand-pipe. The proposed contract is to be voted upon by the town July 8. It provides for an annual rental of $2,850 from the town. L. D. CORDNELL is President of the company, and P. K. CORDNELL, is Chairman of the Water-Board. Population, 3,500.

Xenia, O.—JNO. P. MARTIN, who has the franchise for works, send the following information:

There will be 14 miles of 14 to 4 in. mains, 125 hydrants, a 3,000,000 gall. pump, and a stand-pipe 20 by 125 ft. The franchise is for 20 years, and the annual hydrant rental is $5,000. Mr. MARTIN invariably employs local laborers, at $1.50 per day, with better results than otherwise.

Greensburg, Ind.—We are indebted to E. F. FULLER, 11 Wall St., New York, for the following:

Construction is now under way, and the works will be put in operation by Sept. 1. E. F. FULLER is Designing, and GEO. C. STEVENS, Constructing Engineer. The supply will be from tube wells, by direct pumping. There will be two compound, non-condensing, Blake pumps, with a daily capacity of 1,500,000 galls.; also 8 miles of cast-iron pipe from Dennis Long & Co., Louisville, Ky., and 100 Ludlow hydrants. Ludlow valves will also be used. The works will cost $100,000, which is the amount of the capital stock and also of the bonds. The franchise is for 30 years, with an annual hydrant rental of $35 each. Population, 6,000.

Monroe, Mich.—Mr. FULLER also sends the following:

The supply will be from Lake Erie, by direct pumping. There will be two 1,500,000-gall. compound, condensing, duplex pumps, 15 miles of mains and 128 hydrants. The pipe and specials will be from the Lake Shore Foundry, Cleveland, O. Ludlow valves will be used. Work was begun June 1, and will be finished about Oct. 1. The franchise is perpetual. The officers are: President, GEO. SPAULDING; Secretary, CLARENCE W. SCOTT; Treasurer, EDWARD YORK. The Designing Engineer is E. F. FULLER; Constructing, CHESTER R. MCFARLAND. Estimated cost of works, $150,000. Population, 6,500.

Onargo, Ill.—WM. P. PIERSON informs us that water-works have been proposed here.

Medicine Lodge, Kan.—We are indebted to KENNETH ALLEN, Kansas City, Mo., for the following:

The population is about 1,600. A franchise for works has been granted to CHAS. H. ELDRED, and plans and specifications have been made by KENNETH ALLEN, D. J. AHER, Medicine Lodge, is Constructing Engineer. The village furnishes the supply of water, which is from Elm creek, 4 miles north, from which a ditch built about a year ago, at a cost of $13,000, conducts water to within ¾ miles of the village. At this point a fall of 60 or 70 ft. may be utilized. The ditch has a capacity of about 840 cu. ft. per minute. The ditch will be continued to a point near the village, where a dam, filter and pumping station will be built. Direct pumping will be used. The original plans provided more large mains than will be put in, plans having been changed to the following: 800 ft. of 10, about 1,375 ft. of 8, 3,010 ft. of 6, and 7,370 ft. of 4-in. pipe. There will be 21 valves and 20 double discharge hydrants. The works are to be completed Sept. 1.

Smith Centre, Kan.—We are informed that works will be built by the village this summer. They will be built about as described in *The American Water-Works Manual*, under Projected Works.

Luling, Tex.—JNO. ORCHARD, Secretary of the Luling Water-Works Co., gives the following:

The company has secured about one-half of the necessary capital and would like to get outside parties to take the balance of the stock. The estimated cost of the work is $18,000. Water will be pumped from San Marcos river to a stand-pipe.

Phœnix, Ariz.—J. M. GARDENER, Superintendent of the Phœnix Water-Works Co., informs us that a new steel stand-pipe, 14 by 100 ft., is now being built by the Jno. O'Brien Mfg. Co., St. Louis, Mo.

Iberville, P. Q.—LOUIS BIRON, Engineer-in-Charge, writes that ¼ mile of pipe will be laid this summer and 3 hydrants set.

Roslyn, Wash. Ty.—The following information is from C. R. BONNELL:

The town wishes to raise $5,000 on bonds to construct works. The bonds will be payable at the rate of $500 a year, with semi-annual interest. The population is about 1,500. Water will be taken from a mountain stream by gravity. The stream has a sectional area of 50 sq. ins. A dam would be necessary. CHAS. MILLER is Chairman of the Council, and GEO. RODAMICK has been employed as engineer.

What Water-Works Men say of The Manual of American Water-Works.

Invaluable as a book of reference for those interested in public water supply systems.—*Boston Journal of Commerce.*

It is necessary in order to act with intelligence to know all the details of a business, and this the Manual supplies. It is well managed as a book of reference, and cannot fail to be in demand now that the rapid growth of towns is making the water supply so important a problem.—Houston (Tex.) *Post.*

Almost invaluable to town authorities who are contemplating, or have invested in, a system of water-works.—Utica (N. Y.) *Herald.*

Of large practical value to those building and caring for this class of property.—*The* (Nashville, Tenn.) *American.*

Altogether the book must prove indispensable to every one connected with the water systems of our cities.—Detroit *Free Press.*

The only deficiency seems to be that occasionally water-works companies refuse to report upon certain items in their financial affairs, in which case an estimate is given by the compiler from the best evidence he can otherwise obtain.— Eau Claire (Wis.) *Free Press.*

An invaluable volume of reference and instruction, conveniently arranged and handsomely printed.—Toledo, (O.) *Bee.*

Its value to the various classes interested in the erection of water-works must be great, as it contains a vast amount of information, just such as they need.—Brooklyn (N. Y.) *Eagle.*

The work seems very complete, and will be very valuable to me.—R. C. P. COGGESHALL, Sec'y New England Water-Works Association, and Supt. and Chief Engr. New Bedford (Mass.) Water-Works.

It is just what we often need, a history of all water-works.—DONALD MILLER, City Engr., Cheyenne, Wyo.